PEST CONTROL

MARCH 1959

Based on laboratory and in-the-field tests

CDC's '59 Pesticide Report . . . Pg. 9

No. 3 in Dr. Minton's Venomous Pest Series deals with

Centipedes . . . Pg. 29

Switch in formulations may be answer to resistance

Purdue Conferees Discover . . . Pg. 30

But
Extra Care Is Still Advised!

At University of Mass., panels cover many pests, but mainly

Eastern PCOs Talk Ants . . . Pg. 43

Stillwater conference yields plans for

Okla. Assn. Phosphate Exposure Test Pg. 48

Southern Meet highpoints reptile, nutria, fire ant control as

Dixie PCOs Study Dixie Pests . . . Pg. 50

Second in termite series from OSU's Parcher & Means:

Chemical Penetration in Soil . . . Pg. 57

It's elm leaf beetle time . . Pg. 64

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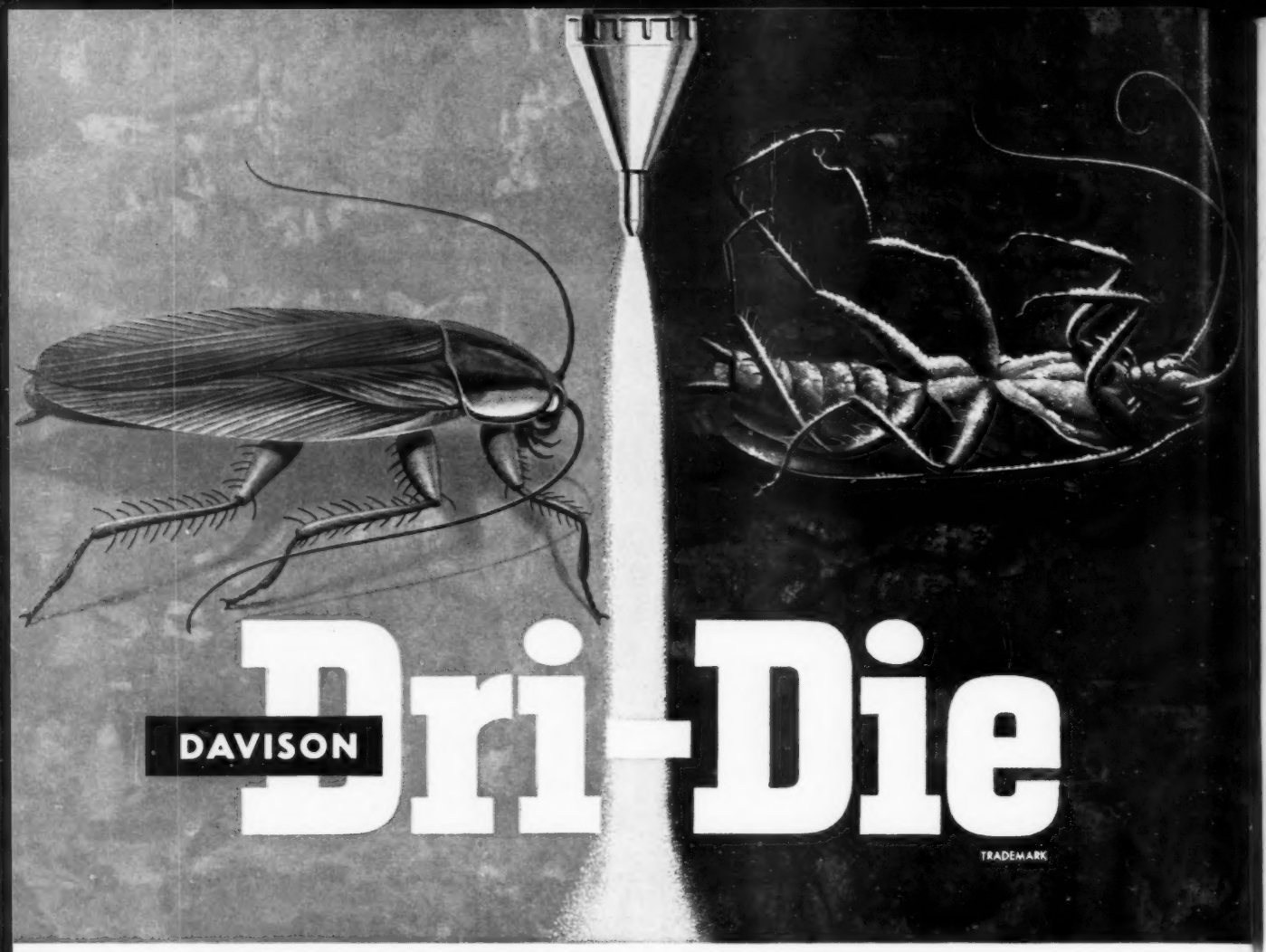

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PEST CONTROL

MARCH 1959

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Vol. 27

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A Refreshing Change

In years past, most of the subjects covered at university PCO conferences were necessarily a repetition of topics included in previous meetings. This year, recognizing a mature industry, authorities introduced entirely new ideas and discussions of advanced pertinent subjects.

New concepts of pricing were presented. The effect of soil structure on termite poisoning was discussed (A 3-part article on this began in February's *PC*). Monthly service of residences was explored. The effect of surface types on results you get from insecticides was also explained, as were *how* insecticides kill, solvents, marketing pesticides, diseases of ornamentals, etc. The full story of the first '59 regional conferences begins on pg. 30 with a report on the Purdue Conference.

Program planning is no easy job and often, because there isn't enough time and cooperation, chairmen are forced to fall back on the old reliables: life-histories, reviews of control methods, ethics, etc. The new, refreshing look this year is the result of capable committeemen, energetic young industry leaders working with new blood at the universities. To these men we say, Bravo! They seem to recognize one day is enough to review old questions many of which are adequately covered in the literature. Let's have more new and stimulating subjects at subsequent conferences.

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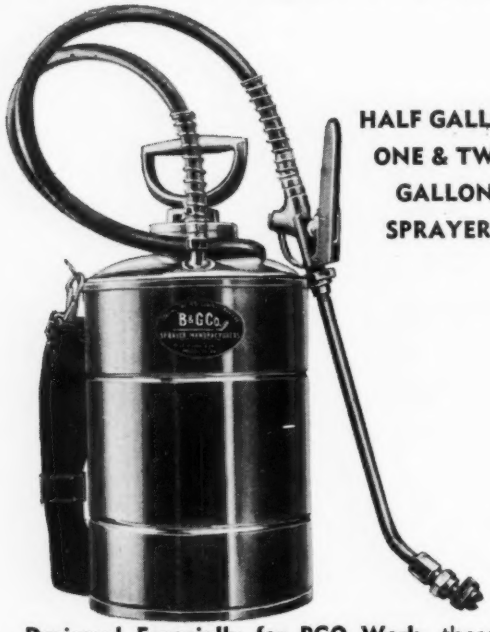

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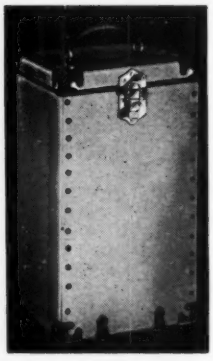

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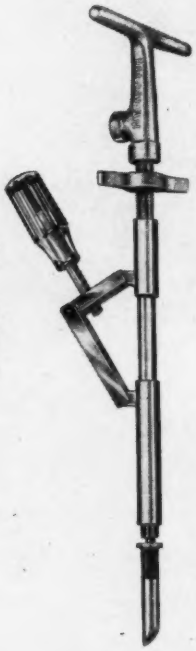

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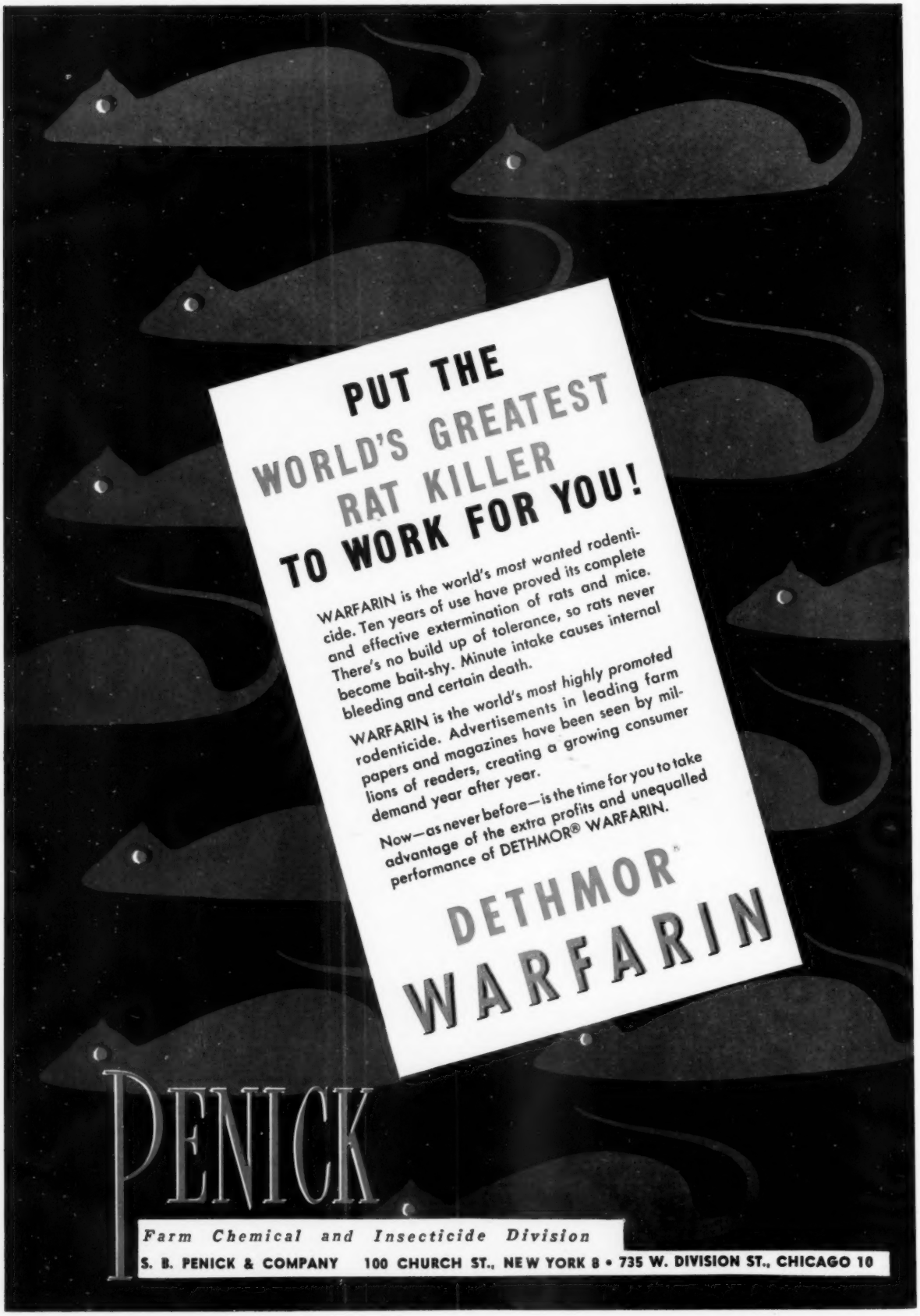
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1959 Report

from the

Communicable Disease Center

PUBLIC HEALTH PESTICIDES

Animal baited huts used to evaluate mosquitocides.

for mosquitoes,

flies, fleas, roaches, bed bugs, ticks, rodents

from the Communicable Disease Center, Public Health Service,
U. S. Department of Health, Education and Welfare, Savannah, Georgia

PUBLIC HEALTH PESTICIDES is an annual release prepared by the Communicable Disease Center on the current status of the chemical control measures for arthropods and rodents of public health significance. The information presented is based on investigations conducted by the Technology Branch, Communicable Disease Center, supplemented by data from the literature and from unpublished material provided by other research organizations.[1] Particular emphasis is placed upon those pesticides which, under test or field conditions, have provided the highest level of control and are compatible with human safety and wildlife. Such a summation precludes the consideration of all chemicals capable of exerting suppressive effects upon the pests discussed. In addition, data on experimental compounds as yet unavailable for public usage are omitted. Information on such compounds may be obtained by writing to the Technical Development Laboratories, Communicable Disease Center, Box 769, Savannah, Georgia. In this annual release, control measures which remained unchanged from those stated in 1958 may be restated verbatim.

In applying the measures described herein, full recognition must be given to the fact that the data discussed relate to tests under certain environmental conditions in specific geographic areas. Thus, the use of a particular measure by the reader under different geographic or environmental circumstances may result in control of a higher or lower level than reported here. In addition, the breeding potential of the insect pest concerned will exert a marked influence on the efficacy of any chemical measure. The latter should be looked upon only as supplemental to the basic element of successful arthropod control—*improvement of environmental sanitation.*

Where no attempt is made toward the reduction of the availability of suitable breeding habitats, chemical control procedures alone may yield disappointing results. Permanent control measures, such as reduction of mosquito breeding sites (by drainage, filling, etc.) or the proper storage and disposal of garbage in a fly control program are a prerequisite to effective abatement. Conversely it is true, that while insecticidal means are subordinate to adequate sanitational measures, maximum control usually cannot be achieved without chemical aids, either as a supplemental or emergency phase. While this comment is true for arthropod control, the same does not apply to disease control since the latter can be, and has been, accomplished in some countries with pesticides alone by affecting only a segment of the insect population (i.e., mosquito vectors entering habitations).

The application of chemical measures for arthropod control is not a simple procedure which can be established routinely without regard to the factors which influence the abundance of the species under consideration. In many instances, the tendency exists to rely on one type of treatment or toxicant, thus making the chemical measure and the operational program one and the same. This approach is inefficient since the individual measures are merely specific tools which on an operational program are to be used at the discretion of the supervisor. From his familiarity with these tools the supervisor is in a position of selecting one or more measures which can best be used in a given situation. Thus, a poultry man, instead of relying on either poison baits or impregnated cords for fly control may find that the combined use of the two techniques will provide the highest level of abatement. The cords would serve as a long-term suppressive measure, the baits being used for emergency applications in the event that sanitary deficiencies cause an upsurge in fly production beyond the control capability of the cords.

In attempts to exert maximum reduction of arthropod populations, operators frequently resort

1. Particular acknowledgment is made to the Entomology Research Division, U. S. Department of Agriculture(A); to the Florida State Board of Health, Bureau of Entomology(B); and to the California Department of Public Health, Bureau of Vector Control(C); for providing certain unpublished experimental data for inclusion in this resume. All references in text to these organizations are by small capital letters as indicated in parenthesis above.

to the use of both larval and adult measures. Unfortunately, the effect of these combined measures may lead to a rapid development of resistance in the insect population. This rapidity of resistance development arises from the increased selection pressure which is placed upon an insect population when both developmental and adult stages are exposed to the same toxicant. In addition, larvicidal treatment alone also may enhance the chance of resistance development since it exposes the population in "concentrated" density in contrast to the relatively "dispersed" state of adult densities; thus creating maximum selection pressure.

In mosquito control operations, DDT and other chlorinated hydrocarbon insecticides may serve as effective adulticides even when resistance renders their use of questionable value in the reduction of larval infestations. To lessen the chances that larvicidal treatments will decrease the efficacy of the same or related toxicant as an adulticide, previous releases have indicated that where larvicides are required, organophosphorus compounds should be employed for that purpose to avoid development or acceleration of resistance to chlorinated hydrocarbon insecticides by the mosquito population, thus making possible longer effective use of the latter group of pesticides against the adults. However, laboratory studies by several investigators now show that susceptible house fly strains selected for resistance to parathion or Diazinon have developed high levels of resistance to DDT, dieldrin, and other chlorinated hydrocarbon insecticides, even though not exposed to any of the latter compounds. From these data, it is possible that the use of organophosphorus larvicides may not prevent the development of, or the increase of resistance to chlorinated hydrocarbon toxicants in the insect population under field conditions. Nonetheless, until such evidence is available from field operations to validate or invalidate this possibility, organophosphorus larvicides are the toxicants of choice when both chemical larvicidal and adulticidal operations are necessary. The exception is in areas where only organophosphorus compounds are effective adulticides. Under this circumstance, larvicides such as Paris green (see page 13) should be employed.

Resistance of arthropods to chemical measures remains the single most important obstacle to the use of pesticides. On a global basis 46 species (including flies, mosquitoes, roaches, bed bugs, lice, and ticks) are reported as being physiologically resistant to one or more of the insecticides commonly employed in their control. Fortunately there are many areas where the public health pests or vector species continue to remain susceptible to chlorinated hydrocarbon pesticides despite, in some instances, the intensive use of such pesticides. However, as a standard operational procedure it is desirable that the susceptibility levels of pest or vector species be measured at periodic intervals. Detailed laboratory tests are not an essential to the detection of resistance under field conditions. Information on available methods for field detection of resistance in public health pests can be obtained by writing to the Communicable Disease Center.

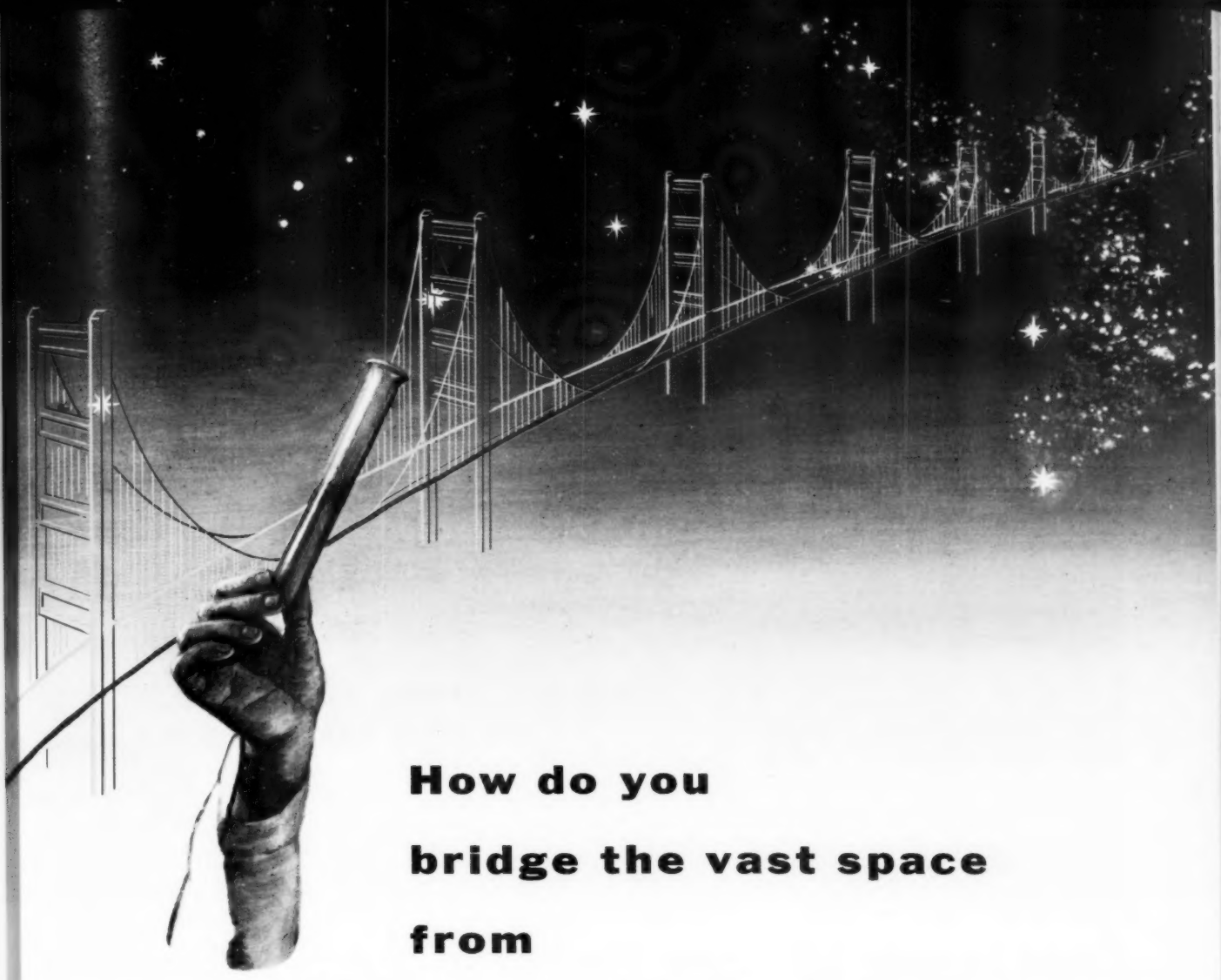
Among the side effects of resistance is the possible error of ascribing the loss of control to this phenomenon when actually the fault may lie in the method of application, toxicant, etc., e.g. adverse wind currents or the absence of air movement may produce negative results with a potent fog treatment which under suitable wind conditions would be highly effective.

Throughout the major part of this release, the dosage of toxicant employed is expressed as technical material in terms of milligrams per square foot, pounds per acre, or parts per million. The dosage of the toxicant applied is dependent upon the concentration of the formulation used, together with the rate at which the material is dispersed. Thus, a 1 percent formulation sprayed on a surface at the rate of 1 gallon per 500 square feet provides a dosage in milligrams per square foot equivalent to the treatment of 1000 square feet with 1 gallon of a 2 percent formulation. The choice in selecting the concentration of a formulation is influenced by the coverage necessary, type of surface, toxicity of the pesticide, transportation requirements, and the equipment available. Methods for preparation of dusts, solutions, etc. of varying concentrations are outlined in the "Operational Memoranda on Economic Poisons" issued by the Communicable Disease Center.

MOSQUITO CONTROL

Among both pest and vector species, resistance to chemical measures continues to remain a factor of increasing importance. Physiologic resistance to chlorinated hydrocarbon insecticides has been confirmed in 20 species, ten of which occur in North America. The most acute development in the resistance field is the recent proof of resistance to dieldrin in three important malaria vectors in North and Central America. The species and areas involved are: *Anopheles aquasalis* (Trinidad), *Anopheles albimanus* (El Salvador, Nicaragua and Guatemala) and *Anopheles pseudopunctipennis* (Mexico). In both Nicaragua and El Salvador, the dieldrin-resistant *A. albimanus* in certain localities exhibit lowered susceptibility to DDT. Except for dieldrin-resistant *Anopheles quadrimaculatus* in Mississippi, this is the first time resistance has been reported for any malaria vector in the Western Hemisphere.

In the United States, the number of resistant species remains at nine (*Aedes dorsalis, A. nigromaculis, A. sollicitans, A. taeniorhynchus, Anopheles quadrimaculatus, Culex pipiens, C. tarsalis, Psorophora confinnis* and *P. discolor*), this resistance chiefly being in relation to the chlorinated hydrocarbon compounds. However, in California, *Culex tarsalis* and *Aedes nigromaculis* have displayed a loss in susceptibility to malathion and parathion respectively. In the Fresno Abatement District of California, *C. tarsalis* larvae and adults were found to have developed resistance to malathion after 2.5 years of suc-



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cessful use of that compound in the area. In 1958 in Kings County, control failures with parathion against *A. nigromaculis* were experienced after 6 years of successful larval abatement with the compound at 0.1 pound of toxicant per acre. Tests revealed larvae from these localities to have an LC-90 level almost 70 times that of two susceptible strains. Slight cross-resistance to Korlan and Trithion[C] were exhibited by the parathion resistant strain but none was apparent to malathion or Guthion.

Larvicides

In the absence of resistance to the chlorinated hydrocarbon insecticides, anopheline or culicine larvae can be controlled by the use of DDT-fuel oil solutions at a rate of 0.05 to 0.2 pound of toxicant per acre. Against DDT-resistant larvae, dieldrin, chlordane, heptachlor, or lindane at 0.1 pound of toxicant per acre can be employed. If these dosages are ineffective in situations where fish and other wildlife are not involved (sewage lagoons, borrow pits), application rates can be doubled or quadrupled.

When mosquito populations no longer respond to control by the chlorinated hydrocarbon toxicants, the organophosphorus compounds are the pesticides of choice. Both malathion (0.5 pound per acre) and parathion (0.1 pound per acre) have been used extensively in California against *C. tarsalis* and *A. nigromaculis*. Except for specific instances of resistance in the two areas previously mentioned, both toxicants continue to give effective larval control in the abatement districts even after repeated usage for 3 or more years. At aerial dosage rates of 0.25-0.5 and 0.05-0.10 pound per acre, respectively, malathion and parathion also are effective against resistant larvae of *A. sollicitans* and *A. taeniorhynchus* in southeastern United States.

In addition to these larvicides, studies by the Entomological Research Center of the Florida State Board of Health indicate that Paris green vermiculite pellets are highly effective against salt marsh mosquito larvae when ground-distributed at a rate of 0.45 to 0.6 pound per acre. To facilitate coverage, the use of granulated formulations containing 7.5 to 10 percent Paris green is advantageous over those with a higher percentage of the toxicant. In circumstances where larval breeding is concentrated in "pot holes" or "cracks" it may be necessary to increase the dosage 3 to 4 times that used for an overall treatment in order to achieve satisfactory kills of the "pocketed" larvae.

The effectiveness of Paris green pellets from aerial dispersal is currently under determination.

Organophosphorus toxicants also have been used to control *Aedes* breeding in irrigated pastures in Oregon and California and *Psorophora* infestations in the rice fields of Mississippi and Arkansas. Parathion when introduced in the irrigation influent at concentrations of 0.01 and 0.1 p.p.m. gave effective control of *A. nigromaculis* in pastures up to a distance of 0.25 and 0.37 mile respectively. Phosdrin at 1.0 p.p.m. or Dipterex at 0.5 p.p.m. produced effective reduction of *Aedes* breeding in pastures up to 0.5 mile but at levels of 0.5 p.p.m. (Phosdrin) and 0.25 p.p.m. (Dipterex), both toxicants gave unsatisfactory control. The efficacy of this method of controlling mosquito breeding in pastures is influenced by the terrain of the field and by other factors such as seepage so that inconsistent results may occur. Seepage also is an important factor in rice field mosquito control. Although excellent kills of *Psorophora* larvae usually are obtained in the terraces near the injection point, infestations in outlying terraces often remain undisturbed. Movement of the treated water through the soil either deactivates or removes the toxicant.

Residual larvicide treatments provide control for extended periods, thus differing from the methods previously discussed in which periodic retreatment is required. In the Savannah, Georgia, area, BHC (12 percent gamma) emulsions applied at the rate of 1 lb. of BHC per acre (in 2 gallons of finished spray per acre applied in the same manner as oil solutions) to small landlocked ponds have given satisfactory control of anopheline and culicine species for periods of 5 to 8 weeks. Despite 3 consecutive years of treatments of five applications per year, no fish kill occurred. In similar ponds, DDT emulsions at an application rate of 3 pounds per acre and dieldrin at 1 pound per acre prevented mosquito production for 3 to 6 and 12 months, respectively. *However, DDT or dieldrin treatments of this type are totally destructive to fish and should not be used where such wildlife is present.*

Residual larviciding with dieldrin, heptachlor, and DDT also has proved effective against *Culex* and *Aedes* species in tests in Oregon, Utah and Montana. In log ponds in Oregon, breeding of *C. tarsalis*, *C. peus* (formerly *Stigmatosoma*), *C. pipiens*, and *Culiseta incidens* was controlled for 14 weeks with dieldrin emulsion and heptachlor granules applied at rates of 3 and 5 pounds per acre respectively. At 10 pounds per acre, DDT was much less effective. At Chinook, Montana, emulsion or granular applications of dieldrin (1.0 lb. per acre) in alfalfa fields, ditches and pastures during one year were shown to curtail breeding of *Aedes vexans*, *A. dorsalis* and *C. tarsalis* the following year. Dieldrin granules applied at 0.5 pound per acre as pre- or post-flood treatments in Montana and Utah study plots (0.1 to 0.5 acre) gave excellent control of culicine larvae (principally *A. dorsalis*) for an entire season. Because of the zero tolerance for dieldrin residues on many forage crops, treatment with this toxicant is applicable largely to "off-field" breeding areas. Studies have shown that both granular and emulsion formulations leave a detectable residue but those from granular preparations are at minimum levels (below 0.6 p.p.m.). Dieldrin at 1.0 pound per acre as a preflood emulsion treatment also has prevented *Psorophora* breeding in rice fields for an entire season where resistance is not present.

Another form of residual larvi-

ciding is found in the use of dieldrin-cement pellets for control of domestic species (i.e., *Aedes aegypti* and *Culex quinquefasciatus*). Incorporation of dieldrin water-wettable powder (50 percent) in sand:cement (1:5) and application at a rate of one 10-gram pellet (content 16.6 percent dieldrin) to two gallons of water has prevented mosquito infestation for as long as 1 year. This technique appears to have value for treatment of fire barrels and similar water storage sites.

In all larvicide applications, the degree of control obtained frequently is dependent upon the type and amount of vegetative cover present. Consequently, where such cover is heavy, it may be necessary to increase the dosage or the amount dispersed in order to obtain satisfactory results. Under this condition, granular formulations usually provide better control than do emulsion or oil spray.

Adulticides

Adult mosquito densities can be reduced effectively by exterior or interior space treatments or by residual applications. Outdoor space applications provide only temporary relief from mosquito annoyance and must be repeated in accordance with the rapidity with which a treated area becomes reinfested from adjacent untreated areas. Residual sprays are active against the mosquitoes for extended periods but may or may not affect the population on an areal basis.

In the United States, the standard residual treatment applied to the interior of dwellings for malaria control purposes is 200 mg. of DDT per square foot (approximately 1 gallon of 5 percent spray per 1000 square feet of surface treated). As the vector, *A. quadrimaculatus* never has shown any indication of DDT resistance, other toxicants are not suggested for over-all interior house application. However, in areas outside the United States, residual application of either DDT (200 mg./sq. ft.) or dieldrin (50 mg./sq. ft.) may be employed. A suspension of either compound is the formulation of choice, both from the transportation and handling aspects as well as from the standpoint of biological effectiveness. The latter applies particularly to DDT since in laboratory tests residues from water-wettable powder display a much greater residual activity than emulsion deposits of the same concentration.

As recent developments indicate some vector populations are resistant to both DDT and dieldrin in Central America, a definite need arises for an effective substitute for these compounds. Laboratory tests and field studies in occupied and unoccupied houses or animal-baited huts now indicate that of the commercial compounds available malathion appears to offer the most promise as a residual treatment against anopheline adults. In animal-baited huts at Savannah, Georgia, plywood walls and ceiling treated with malathion at 100 or 200 mg. per square foot gave 95 to 100 kills of susceptible, "free flying" *A. quadrimaculatus* females for periods of 15 to 17 months. Similar effectiveness prevailed with malathion: DDT (50:100 mg./sq. ft.) applications. Against dieldrin resistant *A. quadrimaculatus*, panels treated with malathion (100 mg./sq. ft.) had yielded 12 months of residual action at the time of the last observation. In unoccupied houses in Mississippi adult *A. quadrimaculatus* females, either "free flying" or in wall cages, showed 100 percent kills for 25 weeks at the above mentioned dosages. In occupied houses treated with malathion (100 mg./sq. ft.) or malathion: DDT (50:100 mg./sq. ft.), wall cage tests reflected 100 percent kills during the entire 4-month observation period. The high level of effectiveness of malathion or malathion: DDT deposits for sustained periods warrants pilot field studies in malarious areas to evaluate this toxicant on the varied surfaces encountered under tropical field conditions. In tests in Arkansas[A] malathion and Diazinon emulsion residues at 200 mg./sq. ft. were shown to be superior to Dicapthon and Korlan in providing effective reduction of *A. quadrimaculatus* in animal shelters and outbuildings for 5-week periods.

Outdoor residual applications are of value as barrier strip treatments around individual premises to give relief from daytime annoyance by certain culicine species. In the Savannah, Georgia, area, DDT applied as a 1.25 percent emulsion at rates of 5 to 10 pounds per acre to the outside of houses and to shrubbery, grass, and other vegetation within a radius of approximately 100 feet of the dwelling caused significant reduction in daytime annoyance from salt marsh mosquitoes for periods of 1 to 9 weeks. The variation in the duration of effectiveness of the DDT treatments was attributed to mosquito potential, more frequent treatments being required when excessive mosquito production occurred. Other pesticides — BHC (1.3 pound gamma isomer per acre), dieldrin (4 pounds per acre), lindane (0.5 pound per acre), Diazinon or malathion (2 pounds per acre) — were ineffective. In Montana, similar application of 5 percent DDT emulsion on farm premises resulted in a 75 to 98 percent reduction of daytime biting rates of *A. vexans*, *A. nigromaculis* and *A. dorsalis* for at least 20 days. Because new populations of mosquitoes usually invade an area at dusk, these barrier strip treatments have little effect on nighttime biting rates.

Outdoor space treatments with mist or fog machines are utilized chiefly against culicine species. Susceptible populations of *Culex, Aedes, and Psorophora* can be reduced effectively by applications of fuel oil solutions of DDT (5 percent), chlordane (2.5 percent) or lindane (2 percent). The dosage rates of outdoor space treatments on an acre basis depend upon several factors including topography, vegetative cover, wind conditions, swath width, etc. In general, treatments which give 0.5 pound of DDT or 0.2 pound of chlordane or lindane per acre provide satisfactory reduction of mosquito densities. However, because of the variables present, it is desirable that a supervisor evaluate the performance qualities of his equipment with the formulations employed and from these data establish operating

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procedures under different weather conditions and terrain. Moreover, the reduction of mosquito densities by space applications is temporary and where the mosquito populations are high, daily treatments may be necessary.

The extent of resistance to chlorinated hydrocarbons in many pest species has led to increasing use of organophosphorus compounds in space treatments. Because of its efficacy against adult mosquitoes and its relatively low mammalian toxicity, malathion is the principal compound used for this purpose. In Florida, extensive tests have shown that malathion (6 percent in fuel oil) fog dispersed at a rate of 8 gallons per linear mile gave kills of 90 and 87 percent respectively of caged salt marsh mosquitoes at 330 and 660 feet. Recent tests [B] of mist sprays of malathion emulsion (6.0 percent) dispensed at a rate of 25 gallons per mile produced average mortalities of caged *A. taeniorhynchus* of 89 percent at distances of 165′ and 330′. Three runs of a 5 percent malathion dust discharged at 40 pounds per mile gave 99 percent kill at the same distances. DDT (6 percent) mist and BHC dust (3 percent, discharged at 80 lbs./mile) were ineffective.

At Savannah, Georgia, malathion fog, dust, and spray treatments[2] made on the same nights in the dosage range of 0.1-0.3 pound per acre[3] showed that each type of application gave somewhat erratic results in different runs, thus reflecting the variability in the environmental conditions prevailing at the time of the individual test. Three fog treatments at 0.1 pound per acre produced caged adult female mortalities of 98, 53, 39, and 0 percent at distances of 135′/ 270′/ 540′/ and 810′.[4] Average mortalities for dust (0.3 pound per acre) and spray (0.2 pound per acre) treatments at the same four distances were 63/81/3/2 and 95/55/32/ and 27 percent, respectively. Although these results reflect a lesser effectiveness of the dust application, the data at distances of 135 and 270 feet at "wooded" sites alone show mortalities of 97/39, 93/94, and 90/37 respectively for the fog, dust and spray treatment. However, the lower dosage employed in the fog application as compared to the other treatments indicates it to be the most effective of the dispersal methods studied. In parallel tests of malathion fogs and dusts at approximately 0.1 pound of toxicant per acre comparable mortalities were obtained at 135′ and 810′ but the fog treatments gave superior kills at the "open" stations at 270′ and 540′. Comparative tests of malathion dusts (4 percent) and sprays produced similar average percent mortalities for both types of treatment. In general, the over-all effectiveness of fogs appears to be slightly above that for sprays and dusts. This fact, together with the operational advantages of the method and its ready public acceptance, favors it as the technique of choice for routine adulticiding.

In a series of 9 tests at dosages of .07 to .09 pound per acre, malathion fog treatments gave average kills of 93, 90, 57, and 17 in "open" sites at 135′/270′/540′/ and 810′. At the "wooded" sites average mortalities of 57, 22, 6, and 11 percent were obtained at the same distances. These data again emphasize the variability in effectiveness that can be easily induced by barriers in the path of the fog.

Tests of malathion versus Diazinon, Korlan and DDVP space applications indicate malathion to be equivalent to or superior to these toxicants. Diazinon and malathion dust treatments at a dosage of 0.1 pound per acre gave average mortalities of 51/42 and 78/53 percent respectively at 135′/270′. In Montana, the dispersal of 3 percent gamma BHC dust at 30 to 35 pounds per linear mile has been shown to reduce effectively nighttime densities of susceptible *A. vexans*, *A. dorsalis* and *A. nigromaculis* in an urban area on the evening of treatment.

In Illinois, limited tests with vermiculite granules impregnated with an aromatic solvent (25 percent) and applied at a rate of 10 pounds per acre to woodland areas indicated that densities of *Aedes trivittatus* and *Aedes vexans* were reduced to minimum levels for periods of 24 to 48 hours. This effectiveness was equivalent to that produced by similar applications of vermiculite granules containing 10 percent DDT.

FLY CONTROL

The intensive use of organophosphorus compounds in house fly control is continuing, but reports indicate an increase in the development of resistant populations in various parts of the United States. Current information shows that populations physiologically resistant to malathion, Diazinon and/or parathion exist in Florida, Arizona, Georgia, and New Jersey. In Georgia, the physiologically resistant populations also exhibit behavioristic resistance to malathion bait, the latter type of resistance apparently being the chief reason why such baits no longer give effective control of *M. domestica* at certain chicken ranches. The areas where resistance to organophosphorus toxicants has developed generally are those in which these compounds have been used intensively. However, the resistance of *M. domestica* to organophosphorus compounds is not of the generalized nature evident with the chlorinated hydrocarbon insecticides; strains at certain farms remaining susceptible while others in the general area display a definite resistance.

Of interest is the observation that at two farms near Savannah, Georgia, the fly populations which were behavioristically resistant to malathion baits in the late summer of one year failed to retain that characteristic over the winter, effective fly control being attained at both sites with the same baits the following spring and summer. However, in a laboratory colony established from one of these field strains and selected under constant exposure to malathion, the behavioristic re-

2. Fog and spray formulations were 6.5 percent in fuel oil; the dust was 12.5 percent.

3. All dosages per acre calculated on a 300′ swath width.

4. Average of cages in "open" and in "wooded" areas.

sistance continued to be observed the following year.

The resistance factor in fly control points up the critical need for stressing the improvement of environmental sanitation as the key to successful abatement. A program based on sanitation supplemented by chemical measures is the best approach to effective control. On such a program the use of pesticides can be kept minimal, thereby retarding the development of resistant populations.

Residual Treatments

In areas where house flies are susceptible to DDT, this chemical is still the insecticide of choice, except in dairy barns or other situations where it may contaminate milk or food. Finished emulsions or suspensions of 5 percent DDT applied to the point of run-off, will provide effective residues.

Where DDT-resistant house fly populations develop, other chlorinated hydrocarbon insecticides can be utilized. Dieldrin (0.625 or 1.25 percent emulsion), chlordane (2.5 to 5 percent emulsion) or lindane (0.5 to 1.0 percent) has provided effective control of DDT-resistant strains when applied to the point of run-off on exterior surfaces of houses (including porches) and animal shelters. Applications of these latter insecticides within homes in the United States should be limited to treatments of selected surfaces such as doors, window sills, and screens. Neither dieldrin nor chlordane is approved for use in dairy barns, but lindane (or methoxychlor at 200 mg./sq. ft.) is acceptable for that purpose.

Two organophosphorus toxicants (Diazinon and Korlan) are currently labelled for use as 1 percent formulations in fly control inside dairy barns, while 5 percent formulations of malathion may be used. The addition of a sugar additive to such organophosphorus formulations generally augments the efficacy of the residues, but the degree of increase in effectiveness varies with the specific toxicant involved. In addition, the concentration of the toxicant influences the importance of this additive. At a treatment rate of 100 mg./sq. ft.

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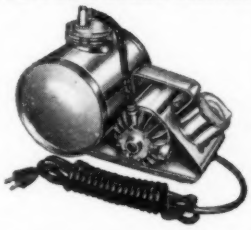

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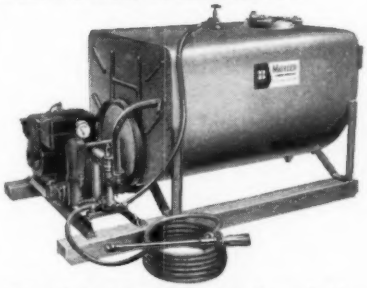

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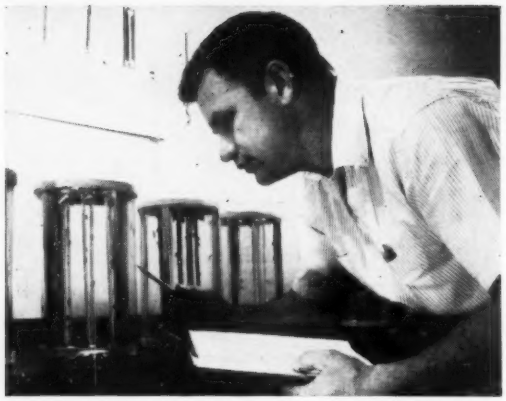

Laboratory evaluation of impregnated cords against house flies, **Musca domestica.**

Diazinon treatments are equally effective with or without sugar, but at 20 mg./sq. ft. the Diazinon-sugar emulsion was superior to the formulation of Diazinon alone. Sugar is usually included in the formulation at a rate of 2.5 parts to 1 part of the toxicant.

The period of effectiveness of residual treatments with organophosphorus compounds shows considerable variation. In the Savannah, Georgia, area, malathion: sugar formulations (200: 500 mg./sq. ft.) gave good control up to 7 weeks while Diazinon: sugar applications (100:250 mg./sq. ft.) yielded similar or higher levels of effectiveness. However, the results, particularly with malathion, were erratic, three dairies showing satisfactory control for 6 to 7 weeks, one for 3 weeks and the fifth for 1 week. In other areas, experimental data for these two compounds reflect control for longer or shorter periods than indicated above, presumably an effect of differences in the fly potential or climatic factors involved.

Korlan has given excellent control of house flies for periods of 8 to 9 weeks in the Savannah, Georgia, area, when applied at a rate of 200 mg./sq. ft. to the interior surfaces of dairies. At 100 mg./sq. ft. with or without a sugar additive, the period of effectiveness of Korlan was 4 to 5 weeks. At 20 mg./sq. ft. with or without sugar, control was ineffective within 1 week after treatment. The toxicologic hazard of this compound is similar to that of malathion.

Residual treatments are effective against other flies that have resting habits similar to those of the house fly. The lesser house fly, *Fannia canicularis*, which frequently is a pest in chicken ranches and dairies, is readily susceptible to residual applications of dieldrin and malathion. Dieldrin at a dosage of 25 mg./sq. ft. remains effective for extended periods whereas the toxicity of malathion deposits is relatively short lived. However, the latter compound will control both *Fannia* and resistant *M. domestica*. Korlan also can be used for this purpose.

In making applications on interior surfaces of chicken ranches extreme care should be taken to avoid feed and water contamination. Since both *Fannia* and *M. domestica* frequently rest out-of-doors on vegetation and exterior walls, treatment should be applied to these surfaces as well as to the interior of the building.

Impregnated Cords

The installation of parathion or Diazinon impregnated cotton cords in animal shelters has provided season-long control of *M. domestica* in the Savannah, Georgia, area. A single treatment with cotton cords (3/32″ diameter) dipped in 5 or 10 percent parathion-xylene solution or with similar cords (3/16″ diameter) immersed in 25 percent Diazinon-xylene solution, reduced fly densities to satisfactory levels for 5 to 6 months in dairy barns. On 25 rural premises, the installation of treated cords in barns, pig pens, chicken sheds, kitchens, and porches produced satisfactory to excellent fly control for 8 to 17 weeks. Similar periods of effectiveness resulted in tests conducted on chicken ranches. Parathion treated cords (3/32″ diameter) were effective in military dining halls and kitchens for 10 weeks as compared to 7 weeks effectiveness for similar size cords impregnated with Diazinon.

In other parts of North America, the duration of effective house fly control has been less than that described above, but except for relatively unsatisfactory results reported from Arizona, extended periods of abatements have resulted from cord installations. On California chicken ranches, tests with parathion-Diazinon cords indicated 6 to 7 weeks of satisfactory control of house fly and *Fannia canicularis* populations. In British Columbia, parathion and Diazinon cords installed at a piggery maintained control of house flies for an entire season. Satisfactory control of *F. canicularis* in dairy barns also has been reported in Utah.

The installation rate for treated cords is 30 linear feet per 100 square feet of floor area. Data indicate that the cord 3/16″ in diameter is essential for season-long control with Diazinon, the smaller cord (3/32″ diameter) yielding only 7 weeks abatement in dairy barns.

Studies of Korlan-impregnated cords in dairies in Savannah, Georgia, indicate that this toxicant is an effective cord impregnant. In 9 of the 10 dairies treated, satisfactory control was achieved for periods of 9 to 16 weeks. These results are of considerable interest since Korlan is the first toxicant of relatively low mammalian toxicity to be of value in the preparation of treated cords. The latter (3/32″ diameter) were dipped in a 25 percent Korlan-xylene solution and installed at the standard footage rate.

Except for Korlan, the toxicity hazards of effective impregnants necessitate that the general public utilize only commercially prepared products which have been approved for use in dairy barns, chicken ranches and food producing establishments. As Korlan impregnated cords are not as yet available and the toxic hazard of

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the pesticide is considerably below that of parathion and Diazinon, it may be feasible for individual operators to dip their own cords. However, for maximum safety it is desirable that the impregnation be made by commercial formulators who are familiar with the precautions that are necessary in handling insecticidal concentrates.

Poison Baits

The basic formulation of the poison baits, currently in widespread use in fly control, consists of an organophosphorus toxicant and a fly attractant (molasses, sugar, or other sweetening agent). The latter may be replaced in part by inert diluents of various types. Pesticides commonly employed in baits and accepted for use in dairy barns are malathion, Dipterex, Diazinon, and DDVP, the latter alone or combined with malathion or Diazinon. None of these baits should be employed inside homes.

Dry baits are formulated to contain 1 to 2 percent toxicant and an attractant. The latter may be granulated sugar or an inert carrier coated or mixed with an attractant. Such baits are usually scattered over the floor surface at a rate of 2 to 4 ounces per 1000 sq. ft. Liquid baits generally are composed of 0.1 to 0.2 percent toxicant and 10 percent attractant. Application is usually by means of a sprinkling can, and the bait is distributed at a rate of 1 to 3 gallons per 1000 sq. ft. of floor area. If the floor surface is dirt, or is covered with debris, the bait should be dispensed on paper or on metal or wooden sheets.

The principal values of poison baits lie in their relatively low cost per treatment and in their immediate suppressive effect upon fly densities. Bait treatments generally produce spectacular reduction of high fly densities within a few hours. However, this effectiveness is of short duration unless further applications are made. Thus, the success of bait applications in controlling fly populations is dependent on the diligence of the operator.

Permanent bait stations are of value in minimizing the attention and time required for dispensing baits. At the same time this practice provides for continual reduction of the fly population. The use of plywood trays (8 to 12 per dairy and charged weekly at a rate of 4 oz. of bait per 1000 sq. ft. of floor area) has been found to provide adequate house fly control for 12- to 15-week periods.

With liquid baits a chicken watering device equipped with a screen wire barrier over the trough to prevent clogging by dead flies, can serve effectively as a permanent station. In recent tests the placement of 17 and 11 such dispensers in a chicken ranch and a dairy barn respectively has resulted in satisfactory fly control for 5- and 6-week periods. Replenishment of the baits usually was required at 3 to 4 weeks or longer intervals. A 12.5 percent sugar water solution of Dipterex (1.0 percent) or of DDVP (0.1 percent) was employed.

Behavioristic resistance to malathion baits has been reported for several house fly problem sites. In these situations, baits containing other toxicants such as Dipterex or Diazinon were readily accepted by the malathion resistant flies. In addition, laboratory tests showed that pyrethrin or allethrin, combined with piperonyl butoxide at a ratio of 1:10, was about equally effective at concentrations of 0.01 to 1.0 percent toxicant against malathion-resistant and susceptible strains of flies. Field tests of similar baits against house flies in dairies showed the pyrethrin formulations to give satisfactory kills which were superior to those achieved with the allethrin formulations.

Outdoor Space Sprays

Space treatments are utilized chiefly in situations where residual and larvicidal applications fail to give satisfactory fly control. As with mosquitoes, this type of treatment produces only a temporary effect on the adult population, consequently at a site of heavy fly production, such as a vegetable cull dump, repeated applications are required. Since the adult kill depends on contact with the insecticidal droplets, treatment must relate to the activity pattern of the flies. In addition, as the quantity of toxicant per specimen is greater for flies than for mosquitoes, mist applications usually are more suitable than aerosol treatments.

Flies which are susceptible to the chlorinated hydrocarbon insecticides can be killed with emulsions or fuel oil solutions of DDT (5.0 percent), chlordane (2.5 percent) or lindane (2 percent). If odor is not a factor, a 5 percent technical BHC emulsion (12 percent gamma isomer) is cheaper than lindane and equally effective. Against DDT-resistant flies, chlordane and lindane are effective. The addition of DMC to DDT formulations also will control DDT-resistant flies. Under field conditions a formulation of DDT:DMC at a ratio of 7.5:1 gave excellent reduction of house flies resistant to several chlorinated hydrocarbons.

Organophosphorus compounds are effective against *M. domestica* resistant to the chlorinated hydrocarbon insecticides, but the dosages required for satisfactory kills are relatively high. Data for limited tests with malathion indicate that dosages of 0.5 pound per acre or higher are required. The effective swath width in these tests was less than 300 feet, the consistent high kills being obtained within 100 feet. (Per acre dosage based on a 100-ft. swath would be 1.5 pounds.)

Recent tests [A] of deodorized kerosene solutions of Diazinon (0.1 percent), Dow ET-57 (2.0 percent), malathion (2.0 percent) and synergized pyrethrin or allethrin (0.1 percent) applied with an electric mist sprayer against house flies in dairy barns indicated that all formulations produced 70 to 98 percent reduction within 10 minutes after treatment. However, most of the applications failed to produce more than 0 to 50 percent reduction 24 hours after treatment even when repeated daily for 5 days to 3 weeks.

Larvicides

Larvicides are of value in fly control for the treatment of garbage or of animal excrement as it accumulates at stockyards, chicken farms, or other problem sites. Since the use of larvicides may

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cause or augment the rapid development of resistance in the fly population, sanitational practices should be regarded as the first line of defense, larvicidal applications being utilized only as an emergency or supplemental measure.

In using chemical measures against fly larvae, the principal difficulty lies in applying the toxicant in such a manner that adequate contact between it and the insects can be obtained. Although flies breed chiefly in the upper layers of a substrate, adequate penetration of media such as excrement, garbage, tomato pulp, etc., is difficult to achieve. Thus, in treating the breeding material, it may be advisable to employ a greater volume of a dilute formulation than vice versa.

Against susceptible house fly strains, chlordane, BHC, or dieldrin serve as effective larvicides. Application should be at the same dosage per square foot as recommended for residual treatments. Aldrin also is an effective larvicide and should be applied at a rate of 25 to 50 mg./sq. ft. Of the numerous organophosphorus compounds toxic to house fly larvae, Diazinon appears to be most effective initially and on a residual basis. Dosage rates of 50 to 100 mg. of Diazinon per sq. ft. are indicated, the formulation being applied at a rate of 7 to 14 gallons per 1000 sq. ft. Other toxicants such as malathion, Thiourea, Dipterex, and Korlan are effective against fly larvae but inferior in control performance to Diazinon.

Although human excrement in privies is a poor producer of *M. domestica*, studies indicate that dieldrin, chlordane, aldrin or BHC applications to the excreta can cause an enormous increase in house fly propagation. The basic factor behind this increase is the interrelationship of *M. domestica*, the soldier fly *(Hermetia illucens)*, and the water content of the excreta. Untreated privies normally show prolific breeding of *H. illucens* in a semi liquid medium, a condition which is fostered by the presence of soldier fly larvae. Such media are not conducive to house fly propagation. However, applications of the previously mentioned chlorinated hydrocarbon insecticides destroy the *Hermetia* infestation, the media in turn becoming semi solid in nature and suitable for the breeding of *M. domestica*. The latter, as a result of being resistant, is unaffected by the chemical treatments. Thus, the adverse effect of pesticide applications on house fly production from privies, as well as the limited breeding of *M. domestica* in untreated structures, indicates that treatment of privies should be avoided.

As a larvicide for use by the individual householder, paradichlorobenzene applied at a rate of 2 ounces per garbage can has been shown to give satisfactory control of fly breeding therein for 1- to 2-week periods.

For the control of blow fly breeding in animal carcasses, several pesticides are effective. One pint of 0.25 percent aldrin, endrin, or Diazinon emulsion applied to dog carcasses protected them from blow fly infestation for 26 to 30 days. Chlordane (0.5 percent), BHC (1.0 percent (15 percent gamma)), and malathion (0.25 percent) were less effective. In carcasses heavily infested with larvae, 0.25 percent emulsions of endrin, Diazinon, and malathion, and 0.5 percent emulsions of dieldrin and aldrin gave complete kill of full grown maggots, while concentrations of 2.0 percent chlordane and 5 percent BHC were required for effective reduction of the infestations.

FLEA CONTROL

The oriental rat flea, *Xenopsylla cheopis*, is readily controlled by the application of a 5 or 10 percent DDT dust to rat runs and harborage areas. While the 5 percent dust is equal to the 10 percent formulation in its effectiveness on *X. cheopis*, the greater toxicity of the 10 percent dust to other ectoparasites normally less susceptible to DDT, such as the cat flea, makes it the formulation of choice.

Reports continue to occur of the difficulty in controlling yard infestations of dog and cat fleas *Ctenocephalides canis* and *C. felis* with repeated applications of DDT or chlordane. Nonetheless, attempts to demonstrate physiologic resistance in the laboratory have been unsuccessful. Parallel tests [A] with fleas collected at a residence where three successive treatments of 1 percent chlordane had failed and with a laboratory strain showed both to be equally susceptible to DDT and chlordane.

Premises treatment [A] with 1.0 percent emulsions of chlordane, Diazinon, malathion, lindane, and Dipterex indicated that Diazinon was the most effective, giving 100 percent reduction for the 63-day observation period. Lindane approached Diazinon in effectiveness while malathion and Dipterex yielded satisfactory mortalities for 7 and 35 days, respectively. Chlordane was ineffective at 1.0 percent but application of a 5.0 percent emulsion gave 84 percent or greater reduction for 63 days. A single test using 0.5 percent Diazinon yielded results similar to those achieved with the 1.0 percent formulation.

Satisfactory flea control on premises is dependent largely on the adequacy of coverage. Treatment of the animal and its quarters alone frequently may not eliminate an infestation because the insect also is breeding at other sites on the premises. When these breeding sites remain untreated, the result is poor control, a condition which may be ascribed erroneously to resistance rather than to inefficient operations.

For flea control on dogs and cats, malathion as a 5.0 percent dust or as a 0.5 percent spray is acceptable. This toxicant also is suitable as an animal dip at 0.25

Utah PCOs: Long Ancestry

Among recent suggestions for a Utah Pest Control Association insignia was one calling for a Mormon cricket and seagull, reminiscent of the state's first pest control operation back in 1848. No professional PCO involved though. That was the year when the seagulls ate the crickets and saved the first crops of the Mormon pioneers.

percent but the treatment should be done under the supervision of a veterinarian.

Other toxicants used as dust treatments for either dogs or cats are rotenone or pyrethrum at 1 percent and synergized pyrethrum (0.2 percent). Lindane (1 percent) and chlordane (2 to 4 percent) dusts should be applied only to dogs.

ROACH CONTROL

The continued spread of resistance to chlordane in populations of the German roach, *Blattella germanica* has led to increasing use of organophosphorus insecticides in roach abatement. However, none of these toxicants apparently provide the persistent level of effective control formerly characteristic of chlordane residues. Compounds in current use include malathion (1 to 5 percent spray or dust), Korlan (2.0 percent spray), Diazinon (0.5 or 1.0 percent spray or 5 percent dust), or Dicapthon (1.0 percent spray). *Diazinon as a 1.0 percent spray or 5 percent dust and Dicapthon are restricted to use by pest control operators only.* Household tests [A] with oil sprays of Diazinon (0.5 percent), malathion (2 percent), Dipterex (2 percent), chlordane (2 percent), and a dust of sodium fluoride, indicated Diazinon and malathion to be the most effective. During the 7-week observation period, the percent reduction averaged 94 to 99. Chlordane gave maximum reduction of nonresistant roach infestations, but against resistant strains only showed a percent reduction ranging from 52 to 93. Sodium fluoride gave 42 to 62 percent reduction for a 3-week period.

With organophosphorus toxicants, residual activity has been shown to vary with the surface treated: (e.g. Diazinon remains effective longer on materials such as wood or wallboard than on linoleum or glass). In addition, staining problems may arise from treating certain types of surfaces such as wall paper, plaster, etc. Dicapthon should be used with caution, particularly on alkaline surfaces.

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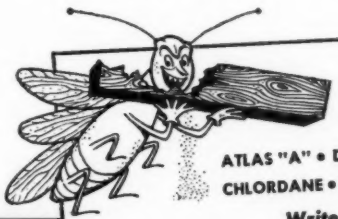

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germanica and for the control of other species of roaches, chlordane up to 3 percent as an emulsion or solution and dieldrin as a 0.5 percent solution or 1.0 percent dust are the insecticides of choice.

Application of any of these pesticides in households or in food handling establishments should be as a spot treatment, utilizing a coarse spray or a dust to treat baseboards, along water pipes, and other roach harborage areas and runways.

To obtain a quick kill in heavy roach infestations or to drive the insects from protected recesses, the use of aerosol formulations of pyrethrum alone or in combination with a residual treatment is of value. Where a combination application is made, the irritation of the roaches caused by pyrethrum activates them to the extent that a greater amount of the residual deposit is "picked up" by the insect.

A development of current interest is the possible use of inert, non-toxic, sorptive dusts (e.g. diatomaceous earths, silica aerogels) in roach control. These dusts, which act on a physical basis rather than a chemical basis, have been shown to be toxic to the various types of household roaches.

BED BUG CONTROL

As bed bug resistance to DDT is not widespread, this pesticide continues to be the insecticide of choice for the control of *Cimex* spp. A single application of 5 percent DDT emulsion or solution to the baseboards, wall crevices, bedsteads, and mattresses of infested rooms usually gives excellent control of these insects.

Where DDT-resistant bed bugs are encountered, lindane (0.1 percent) or malathion (0.5-1.0 percent) can be utilized. With either insecticide, the treatment of mattresses and upholstery must be done with care so that only a light application of the toxicant is obtained. Under no circumstances should these materials be soaked with spray. As an added precaution, the bedding used by infants should not be treated. Retreatment of mattresses and furniture should not be made at less than 2-week intervals. For treatment of baseboards and other hiding places (except bed or mattresses) the concentration of lindane should be increased to 0.5 percent.

Synergized pyrethrin sprays (0.2 percent pyrethrin) also are effective against DDT - resistant bed bugs, but two or more treatments at intervals of 2 to 6 weeks may be required.

TICK AND CHIGGER CONTROL

Ticks, principally the brown dog tick *Rhipicephalus sanguineus*, occasionally invade dwellings and cause severe annoyance to the occupants. Formulations containing 3 percent chlordane, 5 percent DDT, 0.5 percent dieldrin, 0.5 percent lindane, or 0.5 percent Diazinon are effective against this species. These pesticides should be employed as *spot treatments* to baseboards, floor and wall cracks, and other harborage sites within the house as well as to the sleeping area of the dog. In areas where the control of this tick by DDT and chlordane sprays has not been satisfactory, lindane applications have given good results. Diazinon also is of value against resistant strains of the tick. Neither Diazinon nor dieldrin formulations should be used on animals, dusts containing lindane (1 percent), chlordane (2-3 percent), or DDT (5 percent) being suitable for that purpose.

Area control of ticks can be obtained with the application of any one of several chlorinated hydrocarbon insecticides. DDT, chlordane, dieldrin, and toxaphene at rates of 1.0 to 2.0 pounds of toxicant per acre, or BHC at a rate of 0.5 pound of the gamma isomer per acre, give effective abatement of ticks under field conditions. Sprays (suspensions or emulsions) or dust formulations of these pesticides produce similar results. The level of control secured is dependent on the adequacy of the coverage. In brushy areas 50 gallons of spray or 40 pounds of dust per acre are required as compared to approximately half those amounts in sites of thin cover such as lawns, etc. Treatments with these chemicals usually prevent reinfestation for 30 days or more.

For controlling area infestations of chiggers, the locality should be treated with toxaphene or chlordane at 1 to 2.0 pounds per acre, lindane at 0.25 or 0.5 pound per acre, or dieldrin at 0.5 to 1.0 pound per acre. Either spray or dust formulations can be employed, special care being taken to insure thorough coverage of the area. Application rates of 40 pounds of dust or 50 gallons of spray per acre may be required.

In treating woodland areas for tick or chigger control avoid application to ponds, streams, and other water courses or to their adjacent margins since these pesticides are highly toxic to fish.

RODENT CONTROL

The importance of sanitation, including proper garbage disposal, food storage, harborage elimination, and ratproofing, must be emphasized. Sanitation is essential to the permanent control of commensal rats and mice, and the use of rodenticides should be regarded as supplementary to sanitation.

The situation with regard to rodent control is quite encouraging, since rats, unlike insects, do not appear to have developed resistance to the available poisons. The slow-acting rodenticides, including warfarin, Pival, Fumarin, and Diphacinone are preferred for use in most situations because of their effectiveness and low degree of toxic hazards to humans and useful animals. Of this group, warfarin has had the widest use in this country.

Anticoagulants

It has been shown that the susceptibility to anticoagulants of the various species of commensal rodents differs. Accordingly, in the interest of economy and safety, the lowest bait concentration consistent with the most effective control should be used.

Dependable control of the roof rat *Rattus rattus* requires the use of a concentration of 0.250 mg. of anticoagulant per gram of bait (0.025 percent). However, field tests have shown that warfarin

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used at a concentration of 0.050 mg. per gram (0.005 percent) is effective for control of the Norway rat *(R. norvegicus)*. Mice react in the same general way as Norway rats, although they show more individual variation. There is evidence that under certain conditions Norway rats may be controlled a little more rapidly, though no more surely, by using 0.100 mg. of warfarin per gram of bait instead of 0.050 mg. per gram. However, where the species of rat concerned is not definitely known or where roof rats are involved, the 0.25-mg.-per-gram concentration should be used. Commercial concentrates generally contain 0.5 percent anticoagulant in corn starch. To obtain the 0.25 mg.-per-gram concentration (0.025 percent), 1 pound of concentrate is diluted with 19 pounds of bait.

Anticoagulant baits may be used for initial rodent control under essentially all conditions, using a minimum baiting period of 2 weeks. Successful rodent control with these poisons depends upon the rodents consuming a small amount of the poison almost every day for several days. Thus, it is essential that an adequate quantity of the poisoned bait be made available until the rodent population is eliminated. Consideration should be given to establishing permanent bait stations for control of rats in places which are subject to reinfestation. Two years of experience with warfarin at Savannah, Georgia, have shown that Norway rats can be controlled in non-ratproof buildings so long as poisoned bait is available, but eradication was not achieved because of the entry of rats from outside. No difference in the residual effectiveness of the 0.100- and the 0.050-mg.-per-gram bait concentrations was observed. The bait stations were inspected approximately every 6 weeks and fresh poisoned bait was supplied.

Pival (2-pivalyl-1,3-indandione) appears, in a general way, to be approximately equal to warfarin in rodenticidal effectiveness. In both laboratory and simulated field tests, the acceptance of Pival baits by roof rats, Norway rats,

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and mice has been good. Laboratory tests showed that Pival and warfarin were about equally good for mouse control. Against roof rats, Pival was shown to be slightly better than warfarin in the laboratory and about the same under simulated field conditions. Both laboratory and simulated field studies indicated that Pival in solid bait was somewhat inferior to warfarin for control of the Norway rat, but that Pival-poisoned water (0.006 percent acid equivalent) with 5 percent sugar as an attractant was slightly more effective against this species than a comparable formulation of warfarin (0.005 percent acid equivalent). Pival concentrations in solid baits should not be less than 0.025 percent.

Corn meal, as well as some of the other ground grains, has proved to be a good bait material for use with rodenticides which require repeated acceptance over several days. However, in many areas the meal becomes insect infested after several days of exposure and must be replaced at frequent intervals with fresh bait in order to assure continued acceptance by rodents. Pival has been found to inhibit the development of a number of insects that infest grain, including flour beetles (*Tribolium* sp.), cigarette beetles (*Lasioderma serricorne* (F.)), saw-toothed grain beetles (*Oryzaephilus surinamensis* (L.)) and flour moths (*Ephestia* sp.). Cockroaches, however, were not affected when fed for 30 days on bait containing 0.25 mg. of Pival per gram of bait.

In laboratory tests, the acceptance of Diphacinone baits by Norway rats and roof rats was good. Warfarin and Diphacinone were about equally effective against Norway rats while Pival and Diphacinone were about equally effective against roof rats.

ANTU

ANTU still holds a definite place as a quick-acting poison for the Norway rat. Its use to reduce large populations rapidly may be followed by the use of anticoagulant rodenticides to achieve complete and lasting control. ANTU should not be used against the same populations more often than about once a year. It induces a persistent bait shyness in rats, and this property makes ANTU ineffective for repeated use against the same rat population. ANTU is not effective for the control of roof rats or mice. Its safety record is good and it may be used in residences and food-handling establishments. The concentration generally employed in solid baits is 2 or 3 percent.

Sodium Monofluoroacetate (1080)

Sodium monofluoroacetate (1080) is still the most effective, fast-acting rodenticide, but its extreme toxicity to man and animals requires that it be used only on certain types of premises and only by carefully trained crews. The precautions necessary for the safe use of 1080 are numerous and involved. They are described in the "Operational Memoranda on Economic Poisons" issued by the Communicable Disease Center.

Baiting Problems

In tests in Savannah, Georgia, corn meal has proved to be the most readily accepted cheap bait. In general, any available cereal may be used as bait material. It is worthwhile to restate that under certain conditions it is very difficult to get rodents to take any bait, e.g., where food is available in great variety and abundance, as in some warehouses. Such conditions constitute baiting problems, a term which implies that the origin of the difficulty lies not in the particular poison used but in the ecology of the rodents themselves. In situations where a variety of other foods are readily available to the rodents, consideration should be given to the use of anticoagulants in water with 5 percent sugar added as an attractant. Obviously, in testing any given rodenticide formulation, it is necessary to be certain that apparent failure of the formulation is not caused by baiting problems. These problems can be solved effectively only through extensive knowledge of the habits of the rodents. Such problems do not occur more frequently when simple cereal baits such as corn meal are used than when complex bait mixtures are used.

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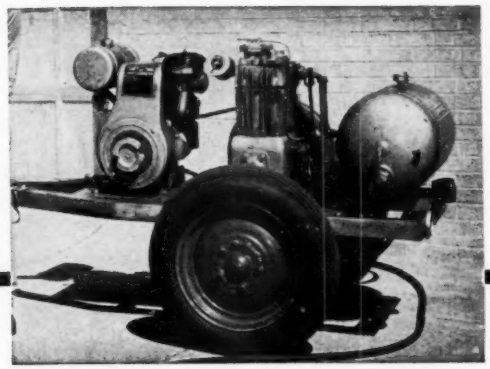

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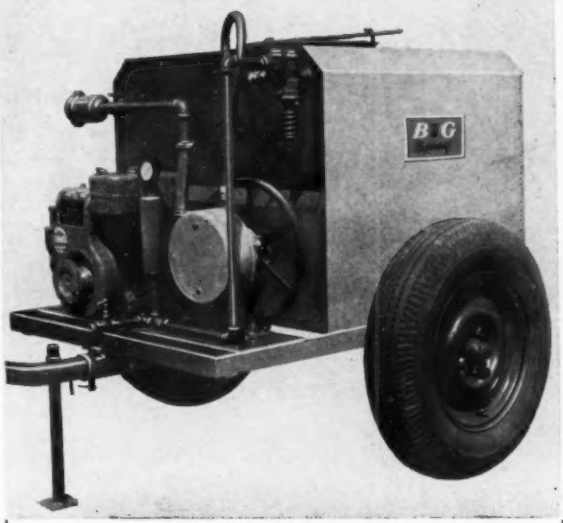

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Venomous Animals, Spiders, and Insects

PART THREE:

CENTIPEDES

by **SHERMAN MINTON,** M.D., Visiting Professor of Microbiology
Basic Medical Science Institute, Karachi, Pakistan

In his first article of this series, which ran in January, Dr. Minton described scorpions and their control; last month he covered stinging insects. The final two installments, to run in April and May, will cover spiders and reptiles, respectively. Nearly a year in production, this series is based upon a talk Dr. Minton gave at the 22nd Annual Purdue University PCO Conference last year.

ALTHOUGH poisonous centipedes figure in folklore and fiction, they are actually of negligible danger to man.

The presence of one rather than two pairs of legs on the body segments, rather long antenna, and a posterior pair of elongated appendages known as anal limbs will distinguish centipedes from millipedes. Centipedes also are more active, agile animals than millipedes. Millipedes do not bite, although some emit pungent and irritating secretions when molested.

All centipedes have a pair of sickle-like fangs on the underside of the head. The larger species of the southwestern United States are 6 to 8 inches long, and some of the tropical giants reach 12 inches. Most of these large species belong to the Genus **Scolopendra.** Some of the tropical species also have luminous organs.

The long-legged, innocuous **Scutigera** is a common household centipede in the U.S. In the writer's experience, the large **Scolopendra** of the southern states live under rocks and rubbish and rarely enter buildings. It is reported the tropical **S. subspinipes** may often be seen in dwellings catching insects attracted to lights.

Fangs of a large centipede are as long and stout as those of n good sized snake, and the centipede has no reluctance about using them if restrained. C. L. Remington reports an Army unit stationed on Leyte experienced a number of centipede bites during the Philippine campaign of World War II. Medical students from the Hawaiian Islands have reported centipede bites are fairly common among workers in pineapple and sugar cane fields there.

Centipede venoms are rather weak, but the bites often result in a painful ulcer that is slow to heal and often becomes infected. Only two fatalities have been reported, one from Arizona and one from the Philippine Islands. Infection may well have been the immediate cause of death in both cases. It is widely believed centipedes sting with their anal limbs or that they have a poisonous spur on each leg. This is not true of any known species.

Control

It has been reported centipedes are killed in numbers when buildings are sprayed with DDT for control of mosquitoes or other insects. Control measures directed primarily against centipedes should rarely be necessary, however.

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At mealtime, in classrooms, during breaks, and late-hour bull sessions, delegates exchange ideas, but conclusion is:

Switch Formulations Before Blaming Resistance, PCOs Decide at Purdue

Resistance in certain roaches and other species of insects with short life cycles and frequent generations will increase — not level off — in years to come.

This is the prediction of Dr. Clifford Roan, entomologist at Kansas State College, Manhattan, who addressed the 23rd Annual Purdue University PCO Conference in Lafayette, Ind. January 26-30. Sponsored in cooperation with the National Pest Control Association, the conference drew over 400 PCOs to Purdue's new $8 million luxury Memorial Center for sessions on insect, rodent, and bird control; general home protection service; safety; insecticide formulations; and new market development. Pest of the year was the cockroach.

"Resistant strains of roaches have always existed, "Dr. Roan said, "but they had not distinguished themselves until a few years ago because their numbers were over-shadowed by the relatively enormous preponderance of normal individuals.

"The insecticidal suppression of 'normal' populations has now allowed resistant individuals and their offspring to prosper and claim our attention."

Dr. Roan also pointed to the possibility of physiological and behavioral resistance.

"We speak of DDT, chlordane, malathion, etc., but these materials are used in control operations as formulations of one sort or another and not as toxicants alone," he related. "Particularly with respect to real or potential behavioral resistance, we should not overlook the probable effects of solvents, surface active agents, carriers, and other additives used in a formulation.

"There is some indirect evidence to indicate that these components may be involved in behavioral responses such as avoidance reactions, etc."

Dr. Roan suggested the PCO first exhaust all other possibilities before he blames lack of control on resistance. The operator should be certain, Dr. Roan indicated, that he is giving thorough and adequate treatment, that routine house-cleaning operations of the customer are not removing or inactivating the chemical before it has had an opportunity to exert its action.

Vernon Walter, Pest Control Services, Inc., Indianapolis, Ind., reiterated the necessity for sanitation and for careful, thoughtful treatment on any roach job. There is no new miracle compound on the market, so the PCO must roll up his sleeves and go to work, Walter said.

Despite resistance, the PCO can't make every call a cleanout, Walter added. So, to cut down the serviceman's time on the job, it was suggested the PCO only periodically treat chairs and tables in a restaurant, the checkout stand in grocery stores, plus other spots where no roaches have been seen or evidence of infestation found.

"However, an island in a grocery store should be treated regularly since it will have plumbing and wiring going to it, and will have extra coffee and perhaps food setting on it from time to time," he noted.

For these areas that are skipped, Walter suggested treatment every other month or even every third month. The dining room of a restaurant, for example, should be treated at least twice a year, he said.

Where to treat and what equipment to use was demonstrated by Dr. Harlan Shuyler, Conservation Industries, Inc., Kansas City, Kans. He said the only way a PCO and his servicemen can cope with roach resistance is by adopting a "roach-eye" view on service calls — by getting down and looking up, looking under and looking back at objects which appeal to roaches as hiding places.

Dr. Philip Spear, technical director of the NPCA, gave recommended dosages and characteristics for some of the chemicals for roach control:

Malathion, which is low in toxicity, and has a short residual life, has some odor problems. The odor is

minimized, however, if freshly-made concentrates are used instead of those which have been in cans on the shelf for a prolonged period. Apply at 2%-4%.

Korlan, which is intermediate between malathion and Diazinon in toxicity, and has a medium residual life, may cause a few staining problems and some odor. Apply up to 2%.

Diazinon is medium in toxicity, and has a medium residual life. Its odor problems vary with each batch. Apply at ½% for maintenance work, 1% for cleanouts.

Dicapthon is low in toxicity, and has a slightly longer residual than Diazinon, as well as some odor and staining problems. Apply at 1%.

In buying dusts for resistant roach control, Dr. Spear recommended the PCO select 325 mesh dust or dust fine enough to pass through 325 mesh screen.

He commented only briefly on silica aerogels or desiccants, an experimental technique for insect control which reportedly dries up the insect.

"It may be another two or three years before we really know this material," Dr. Spear remarked. "Right now it's something new to us and doesn't fit in with our usual pattern of control."

Dr. Spear mentioned the possible market which may exist in the future for Tabatrex and R-11 repellents for roach work. He said these chemicals might be used in the cases found in bottling plants to prevent roach infestation of the bottling works from homes where the cases have been used.

Habits and characteristics of roaches which can also be used to help control them were defined by William Butts, instructor of Purdue's four-year course for PCOs.

Butts also pointed up the importance of darkness, high temperature, and humidity as factors favorably affecting cockroach development.

Dr. Roan, Dr. Spear, Dr. Shuyler, Walter, and Butts later joined together, along with moderator Elmer Jones, Jones Pest Control, Inc., Owensboro, Ky., for a panel to recap the cockroach program.

Pricing Roach Jobs

Pricing roach jobs where resistance is a problem was handled in an audience-participation, question-and-answer period, featuring panelists John K. Medoff, Hudson Exterminating Co., West New York, N. J., Phyllis Kerstein, Advanced Exterminating Service, Chicago, Ill., and Robert M. Russell, technical director of Orkin Exterminating Co., Atlanta, Ga.

Getting ready. Preparation of the 145-page manual each Purdue delegate received, started weeks in advance, but it took a crew of over 25 entomology students and staff members to collate the volume the day before PCOs began to arrive. In the middle photo, department head, Dr. John V. Osmun (left) works with Professor B. E. Montgomery, and graduate assistant Mercer Russell (right), inserting pages into stiff-cover binders. Two PCO ent students collected, killed, dried, pinned, and mounted over 4,000 roaches so each registrant could take home a box of 10 different specimens of the "pest of the year" for serviceman training and easy identification. Shown in the bottom photo are (left) Paul Estes from Memphis, Tenn., and Vince Scala, whose home is located in Brooklyn, New York.

Asked how her company handles price increases due to roach resistance, Miss Kerstein remarked that she simply approaches the customer and outlines the problem sensibly.

"We explain resistance in terms the customer can understand," she said. "We tell the customer it's like medicines which a doctor may give you. Your body can build up a resistance to them. This is the same way roaches become resistant. We have had no trouble with price increases."

All three panelists said contract customers should not be charged for call-backs. Remarked Russell:

"Extra charges not only destroy your billing continuity, but they also jeopardize a good account which the PCO has spent years in building up."

In a talk on price increases in roach control, John Medoff stressed the need for an upward pricing adjustment to compensate for resistance.

"For every 100 man-hours of service work during 1955," Medoff observed, "one company spent an additional 5.7 hours on normal complaints. Under resistant roach conditions, complaints constitute 12.5 hours for every 100 man-hours of service work. This brings the efficiency of route operation to 87.5% today.

"Never 'ask' the customer for a raise in price. Simply tell him the new price will be so much or that the increase will be so much. On small jobs, the situation can be explained on a printed form, not much bigger than a 3 x 5 index card. Large jobs will require a more detailed letter, and on big jobs, better see the customer in person."

Soil Characteristics Affecting Termite Chemical Persistence

On the termite portion of the program Dr. Paul E. Lichtenstein of the Department of Entomology, University of Wisconsin, Madison, described insecticides used for termite control and their persistence in various types of soil.

"There are six main factors," he said, "which affect persistence of a soil insecticide: the soil type, application rate, presence or lack of cultivating, soil temperature, soil moisture, and soil micro-organisms."

In soils with a high organic content such as muck, insecticides will persist longer than they will in a soil such as sand which has a low organic content, Dr. Lichtenstein explained. Likewise, insecticides applied at a higher application rate will persist relatively longer in a soil than insecticides applied at a lower application rate. Cultivating the soil, he added, brings a more rapid loss of the insecticide than if the soil is not cultivated; a high soil temperature brings more rapid breakdown of the chemical than a lower temperature; and insecticide in a wet soil will lose its effectiveness more rapidly than the same insecticide in a dry soil.

"Lack of moisture," he said, "might be responsible for inactivating micro-organisms that could influence the breakdown

of insecticides in soils. During tests in which soils had been sterilized, insecticides persisted considerably longer than in non-sterilized soils."

H. R. Johnston, Head of the Forest Insect Laboratory of the U. S. Forest Service, Gulfport, Miss., described other soil chemical experiments in Gulfport and up-dated his test results published in the February 1958 issue of PC (pg. 9).

Of the termite soil chemicals tested by his laboratory since 1944, Johnston listed the following as the most effective:

Aldrin at 0.5%—still 100% effective after 9 years.
Benzene hexachloride, 0.8% gamma—80% effective for 10 years.
Chlordane, 1.0%—still 100% effective after 10 years.
DDT, 8.0% — 90% effective for 11 years.
Dieldrin, 0.5%—still 100% effective after 9 years.

"Heptachlor is a promising insecticide as a soil treatment," Johnston reported, "but has not been tested long enough to compare its effectiveness with any of the other five."

Johnston added that by increasing the concentration, the duration of protection is increased.

"With DDT, for example, a concentration of 2% gave four years of protection; 4% gave six years protection, and 8% gave 11 years," he noted. "As another example, a dosage of ½ pint of 0.4% gamma BHC gave good protection for five years, while a 1-pint dosage gave eight years of good protection.

"During the past two or three years, extensive tests have been established in Mississippi, using extremely low and high concentrations and rates of application of chlordane and dieldrin. The object of the low treatments is to find the breaking point of these insecticides. The object of the high dosages is to give protection as long as possible. These tests are too new to draw any conclusions yet."

Although the Federal Housing Administration rejected the NPCA's proposal for soil pretreatment certification, an FHA certification program for the industry is still a possibility, according to Dr. Ralph Heal, NPCA executive secretary.

He told conferees the National Association of Home Builders, representing 40,000 members of the building trade, has officially gone on record with the FHA as opposing the five-year warranty now demanded for termite pretreatment jobs on FHA-financed homes. The NAHB, Dr. Heal indicated, is seeking instead a one-year guarantee to reduce the burden of responsibility on the builder.

The balance of his remarks on certification followed the line of his talk at the Southern Conference (see pgs. 53-54).

Slides illustrating how to drill and treat slab homes, plus the construction failures which lead to termite infestation, were shown by Robert C. Yeager, Rose Exterminator Co., Cincinnati, O.

Characteristics and control of the drywood termite (**Kalotermes** spp.) were discussed by B. B. Gillespie, a graduate assistant in entomology at Purdue.

He said the drywood is found mainly in parts of Virginia, South Carolina, North Carolina, Georgia, Florida, Mississippi, southern Texas, and southern California. However, it may be imported into any other southern or northern state on lumber or wooden furniture infested before or after manufacture.

Horntails Gnaw Wood in Growing Number of Homes

The biology of another wood-infesting insect — the horntail — was described by Dr. Leland Chandler, Purdue Department of Entomology.

The adult male, he said, is 1¾" long; the adult female, about 2¼".

"There are three major reasons for the recent increase in horntails emerging in homes," Dr. Chandler said. "The main factors involved are the rapid rate of house building in the U. S., the growing percentage of pine and related softwoods used in these homes as building materials, and the demand for lumber that is seriously threatening our resources. There is now a trend toward utilization of fire-damaged, diseased, or insect-killed or weakened trees, which the horntails are known to attack.

"If the actual boring damage is not significant, the introduction of a good fungicide and perhaps a residual insecticide at the same time will prevent secondary invasions by fungi or other insects."

Reports of suspected infestations have been received from Cleveland, Lima, and Akron in Ohio; Detroit, Mich.; and Milwaukee, Wisc., he reported.

Several infestations of Western horntails that occurred in Milwaukee were described by Marcel Friis of Wil-Kil Pest Control, Milwaukee.

Friis said building fumigation or chemical treatment to control the horntail is difficult since the insects are usually embedded in the center of 2 x 4's or other lumber and sealed in tightly, usually in studs between walls. This makes it difficult for gas or chemicals to penetrate. Therefore, he said, any control method is not 100% effective.

Market for Home Service

In a special session on home protection service, Frank Harder, Jr., Harder Extermination Service, Inc., Hempstead, N. Y., identified the various services which the PCO can offer in this market. He said over 50% of his company's income is derived from such service.

"Most frequent household control work," Harder said, "will be for cockroaches, ants, and fleas, depending upon the section of country involved. Other calls may cover any of the other common household pests: spiders, silverfish, flour beetles, weevils, bedbugs, ticks, clovermites, carpet beetles, furniture beetles, clothes moths, termites and, in the rodent family — rats and mice, particularly those seeking winter shelter.

"On the outside of the home, the growing popularity of the backyard barbecue and swimming pool has likewise enhanced the demand for pest control. There the PCO may find a need for a fog machine to control mosquitoes, flies, and gnats on a periodic basis throughout the summer or for one-shot treatments for parties, lawn weddings, etc.

"Finally, there are the ornamental and plant pests which infest trees, shrubbery, and gardens. Linked to this is lawn care, liquid fertilizing, fungus control, grub-proofing, and possibly broad-leaf weed control."

A breakdown of professional groups purchasing his company's home pest control service in one southern city of 100,000 population was given by G. L. Edwards, Redd Pest Control, Jackson, Miss.

Edwards said business owners accounted for 28% of the company's home service volume; doctors, 10½%; salesmen, 10%; pro-

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fessional men -- engineers, chemists, teachers, geologists, etc., 8%; skilled labor, 6%; insurancemen, 6%; attorneys, 5%; oil men, 5%; Government workers and politicians, 3%; "white collar workers"— clerks, bookkeepers, etc., 3%; real estate men, 2½%; retired persons, 2½%; and banking officials, 1½%. Nine percent of the volume was left unclassified.

What are the collection problems in home protection service? Edwards listed five: customers who (1) don't want to write a check for small amounts except once in three or six months; (2) are always 30 days behind in payments; (3) get behind at tax paying time, auto tag buying time, Christmas, etc.; (4) move out of the state; and (5) intend simply to "beat" the PCO.

To minimize these problems, Edwards said, start first with better selling:

"Know that the person to whom you're selling the service is capable of paying for it, know the prospect if possible, don't sell something you can't deliver, don't guarantee, have a clear and definite understanding as to how work is to be paid for and when payments are due. And finally, set up checks to see if accounts are paid on time. This can be a friendly reminder such as department stores use, or you can have the serviceman present a bill when he services the customer the next time."

The equipment and personal qualities which a serviceman needs for household pest control were summed up by Joe White, Central Service and Exterminating Co., Cleveland.

"The characteristics of the successful residential serviceman are the same as those of a successful commercial or industrial serviceman, but they are carried to a higher degree," White explained. "The residential serviceman must be an expert technician, and he must be responsible, affable, and neat."

Fabric Pest Control

In the mothproofing and moth control phase of home servicing, Hamilton Laudani, assistant head of the Stored-Product Insects Section, U. S. Department of Agriculture, Beltsville, Md., identified the most important species of fabric pests in the home and prescribed chemicals for their control and prevention in fabrics.

He listed the most important species as the webbing clothes moth, casemaking clothes moth, black carpet beetle, furniture carpet beetle, varied carpet beetle, and carpet beetle, **Anthrenus scrophulariae.**

To treat 10 square feet of wool rug or carpet of a better than average grade, Laudani suggested either ½ pint of a 5% DDT solution or 1 pint of a 2½% DDT solution; methoxychlor, Perthane, or Strobane at 1½ pints of 3% solution; or silicofluoride (magnesium), at 1½ pints of a 2% solution. Another alternative would be mothproofing compounds, he said.

"In selecting the base for the insecticide," Laudani warned, "the PCO should recognize the limitations of both water and oil. Water has poor penetration, may possibly stain, damages soluble sizing, shrinks fabrics, has a mildew effect, and corrodes metals. On the other hand, oil may affect rubber sizing on the back of a rug, the rubber pad under the rug, or the floor if it is made of asphalt tile."

In applying the insecticide, Laudani recommended either spraying or "padding or sponging" the chemical on. If the PCO sprays the fabric, he should use a low air pressure, fan-type nozzle with clean and leak-proof equipment. The surface of the rug should not be disturbed until it is dry, he stressed. The padding or sponging method of application is used for upholstery, but only experienced persons with a knowledge of textiles should attempt it, he advised.

For regular fabric insect control, he said the PCO could use an insecticide with either a contact, residual, vapor, or fumigation mode of action.

As contact and residual sprays, he recommended ½% lindane, ½% dieldrin, 2% chlordane, 5% DDT, and 2% malathion.

"These should be applied," Laudani said, "as wet sprays to all possible infestation areas such as cracks in floors, cracks and spaces under and behind baseboards, closet floors and shelves, behind radiators, in ducts, and under any type of floor obstruction."

To treat wall and floor spaces infested with carpet beetles, he added that dusts of 1% lindane or 5% chlordane are "very useful."

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not recommended for use in homes," Laudani stated, "but they are very useful — particularly aerosols containing lindane and DDT — when used periodically in warehouses and industrial establishments."

Sanitation plays a big role in fabric insect control, Laudani advised. "Discard all infested, old, and unused woolens, furs, and articles which contain feathers and animal hairs. And clean up, preferably with a vacuum cleaner, all areas where lint has accumulated such as in cracks and crevices in the floor, and behind baseboards, closet shelves, heating and ventilating ducts, etc."

Asked about the residual effect of lindane, Laudani said he has observed one instance when it was applied on wool and is still effective after four or five years.

Test Fabric Pest Feeding Habits on Synthetics, Stains

Tests of the feeding habits of moths and carpet beetles on synthetic fabrics and stains which help attract these pests were described by Arnold Mallis, Gulf Research and Development Co., Pittsburgh, Pa.

"When large larvae of the furniture carpet beetle, the black carpet beetle, and the webbing clothes moth were given a choice of feeding on pure wool cloth or on cloth with combinations of nylon and wool, Orlon and wool, and rayon and wool, they preferred to feed on the pure wool cloth," Mallis indicated. "In time they would also slightly attack the cloth with combinations of wool and synthetics.

"Stains such as human urine, human sweat, tomato juice, milk, beer, black coffee, and beef gravy are attractive to the larvae of clothes moths and black and furniture carpet beetles. Such stains as butter, tea, cola soft drink, and a 5% sugar solution were not attractive to the larvae of clothes moths and carpet beetles."

He said large and small clothes moth larvae and small larvae of the furniture carpet beetle damaged woolens with these attractive stains. Large larvae of the furniture carpet beetle were "definitely" attracted to stains of tomato juice and beer and avoided or showed only an occasional preference for the other stains. Small larvae of the black carpet beetle were strongly attracted by stains of human urine, tomato juice, and beer, and large larvae of the black carpet beetle were not attracted by any stains, he said.

"The cleaning or washing of woolens to rid them of stains will discourage feeding by the larvae of the webbing clothes moth, as well as small larvae of the furniture and black carpet beetles," he continued. "Woolens are eaten by large larvae of the black carpet beetle whether they are stained or not, and to a lesser degree, this also applies to large larvae of the furniture carpet beetle. Therefore, even freshly cleaned woolens must be treated with mothproofing spray to protect them fully from fabric pests, especially from the large larvae of carpet beetles."

In other tests, Mallis said the webbing clothes moth, the black carpet beetle, and the furniture carpet beetle did not feed on clean fabrics made from Orlon, Dynel, and Dacron. Where carpet beetles had no other food, clean nylon was slightly damaged.

"Clothes moths and carpet beetles," he reported, "did not feed on Orlon or Dynel when these fabrics were stained with three stains highly attractive to these fabric pests, namely — tomato juice, human urine, and human sweat.

"When given no other choice of food, the furniture carpet beetle will extensively damage stained areas of nylon and Dacron. The black carpet beetle under similar conditions will cause extensive damage to nylon stained with human sweat. The time from egg to adult for clothes moths and carpet beetles was greatly shortened when these insects fed on wool stained with tomato juice."

Mallis repeated that anyone interested in mothproofing must know the effect of water-base and oil-base sprays on fabrics, as mentioned by Laudani. In staining tests he participated in, the effects of tap water and Gulf Research's insecticide base oil, Gulfspray Naphtha, which is said to be similar to the usual fly spray bases on the market, were evaluated.

When water was used, Mallis said Celanese acetate was badly spotted; nylon, silk crepe, silk shantung, viscose rayon, and Orlon — slightly spotted; and Dacron, Dynel, and Vicara — not affected at all.

When oil was used, Celanese acetate was badly spotted; nylon, silk crepe, silk shantung, Dacron, Orlon, and rayon—slightly spotted; and wool and Dynel — not affected.

Most of the stains from oil-base sprays could be removed by immersing the stained cloth in Stoddard's solvent, he indicated.

Ornamental Pest Control Covered by 4 Speakers

Another conference session was set aside for ornamental pest control. Dr. D. L. Schuder, assistant professor of entomology at Purdue, showed a series of color slides on various insect pests of trees, shrubs, and lawns.

Following his appearance on the program, he joined a panel on ornamental insect control, composed of Frank Harder, Jr., Harder Extermination Service, Inc., Hempstead, N.Y.; Charles Knote, Cape Chemical Co., Cape Girardeau, Mo.; and Dr. Lee C. Truman, Pest Control Services, Inc., Indianapolis, Ind.

In the chemical end of the discussion, Knote said he was interested in a new water-based phosphate insecticide, Trithion, manufactured by the Stauffer Chemical Co. He claimed he has trouble with malathion and toxaphene breaking down after four to six days of continually hot weather, said he has reports that Trithion is more stable. It is said to have a high rate of oral toxicity, however.

Dr. Schuder added that Trithion looks like a "good" possibility, but Purdue is not recommending its use as yet. One operator in the audience who had used Trithion in oil on almond trees reported "good luck" with it.

Fly Control with Repellents

Other chemicals — these for fly repellency — were covered by Z. Z. Dworkin of the Glenn Chemical Co., Inc., Chicago, Ill.

By using repellents for fly control, Dworkin said, the PCO will get quicker results, and he won't have the resistance problem that he might with insecticides. Most repellents also are non-toxic when formulated and used as directed.

"They can be used with a toxicant to obtain longer lasting results, or without a toxicant to avoid the presence of dead insects," he said. "Additionally,

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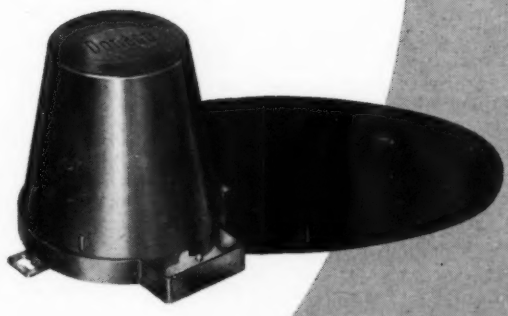

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they are highly useful for forcing fly populations out of one area into another baited area."

Dworkin said tests have shown there is a mutually sustaining action in a combination of pyrethrins and Tabatrex, a repellent manufactured by Glenn Chemical.

The sustaining effect of Tabatrex on pyrethrins, he claimed, was indicated by the fact that long exposure to ultra-violet light and high temperatures did not speed up the deterioration of pyrethrins, as reportedly occurs when pyrethrins are used alone or with a synergist.

Mosquito District Can Help PCO's Business

In the closely related field of mosquito control, Dr. Maxwell J. Wilcomb, Jr., technical supervisor of the Hammond Vector Control Demonstration, U. S. Public Health Service, Hammond, Ind., gave conferees a picture of how a mosquito control district is set up and where its area of operation can dovetail with that of the PCO.

"The work of the district consists of routine source reduction, larviciding, and, less commonly, adulticiding within the district's boundaries," Dr. Wilcomb said. "These are not activities normally conducted by PCOs. However, PCOs ordinarily do perform mosquito adulticiding work for individuals or by contract in neighborhoods. This is work which cannot be performed by the district.

"Thus, problems not the responsibility of a district — such as requests for 'bonus' control of mosquitoes, mites, thrips, box elder bugs, hornets, pigeons, etc. — may be referred to the PCO. Districts also may purchase some supplies and equipment through PCOs who are authorized dealers."

He said at least 24 states have mosquito abatement districts, based on a 1955 census. They are Alabama, Arkansas, California, Connecticut, Delaware, Florida, Illinois, Maine, Massachusetts, Minnesota, Mississippi, Montana, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont and Virginia.

Phostoxin—New Grain Fumigant

For grain insect control, the use of Phostoxin, a new phosphine grain fumigant in tablet form, was described by J. Wilfred Gunn, Hollywood Termite Control, Los Angeles, Calif.

Although Phostoxin was just recently introduced into this country under Gunn's sponsorship, he said it has been in world distribution for five years. Its active ingredient, he commented, is aluminum phosphide, which releases phosphine gas.

"It decomposes slowly in grain," he said. "In grain with a temperature of 70°F. and higher, three days are required; in 60°F. to 69°F., four days; and in 50°F. to 59°F., five days. Decomposition starts about one hour after application."

Gunn said there is no hazard to the operator during the first hour if he is probing the grain with Phostoxin, but after the first hour, it would be necessary for the fumigator to use an all-purpose gas mask.

"If you can't apply this fumigant in less than an hour, don't use it," Gunn said. "This is a very effective material, but it is also dangerous and should be treated with respect."

"Tablets can either be applied by dropping them into the grain stream as it flows into the bin or they can be probed into the grain mass. Depths up to 30 feet can be treated by probing."

Little if any sealing is required, he noted. According to Gunn, only hatches in the head house of concrete elevators need sealing; in quonsets, just ventilators are sealed — then only because of possible wind conditions. No sealing is needed in Butler-type bins, he claimed.

Depending on the quantity of Phostoxin purchased and dosage rate, the cost of the fumigant will vary from 1/3c to 1.8c per bushel.

Lights Way to Insect Control

A totally different concept in insect control — the use of light — was covered by Dr. H. O. Deay of Purdue's Department of Entomology.

"Electrical lamps," he said, "can be used to estimate the presence and abundance of insects. This would enable the operator to predict insect outbreaks more accurately and thus time control measures better. Lamps are also useful for determining results of control measures, repelling insects, attracting and destroying them, and attracting them away from one area and into another."

He said, however, that an insect's response to a light is reduced by winds of more than 6 mph or temperatures below 60°. When there is a full moon, the insect, likewise, will not be attracted to a lamp as readily as on a dark night.

"And if there is competition between a light you install as a repellent and a natural attractant that exists in the same immediate area, one of the two will have major dominance over insects you're trying to repel, and determine whether they leave the area or not. Thus, a repellent light you use successfully in one area may fail completely in another."

"For outdoor garden parties or barbecues," Dr. Deay continued, "the PCO might try both a lamp that repels an insect and another that attracts it. Where the main party activity is to be concentrated, use a yellow light to help keep insects out of that area, then a black lamp about 50 feet away to draw the insects to a specific spot."

Dr. Deay said his current studies with light in insect control will probably be concluded in about three years.

Rat Control in Sewers Too Small for a Man

Shifting to rodent control, Mark Worcester, U. S. Fish & Wildlife Service district agent, Mitchell, S. D., pointed out how to control Norway rats in sewers 18 inches or less in diameter, in which a man cannot work.

"Once a city authorizes a rat control program in its sewers," Worcester said, "it is advisable to examine the maps of the sewers in the city engineer's office, before any poisoning is done.

"More often than not you will find cross connections between the sanitary and storm sewers. In one city we found connections where the storm sewer drained into a lake which supplied the city's drinking water. Because most storm sewers empty into rivers, the PCO should also check state laws. In Nebraska, for instance, one can be prosecuted for introducing any poison into any stream or river."

For baiting in the Dakotas where he works, Worcester said sodium fluoroacetate is the most efficient and cheapest poison to use. He recommended a formula containing 18 pounds of corn meal, 10 pounds of oatmeal, 10

pounds of bread crumbs, ¾ pound of Avenex, (antioxidant which reduces rancidity), 1¼ pounds of powdered sugar, 2½ quarts of crude corn oil or crude peanut oil, and 1½ ounces of sodium fluoroacetate.

Where health hazards exist and sodium fluoroacetate cannot be used, he recommended either red squill or zinc phosphide. The red squill formula: 17½ pounds of bread crumbs, 17½ pounds of oatmeal, 10 pounds of horse fat, 1 pound of Avenex, and 4 pounds of red squill. The zinc phosphide formula: 18 pounds of corn meal, 8 pounds of oatmeal, 8 pounds of bread crumbs, ¾ pound of Avenex, 1¼ pounds of powdered sugar, 2 quarts of crude corn or crude peanut oil, and 6½ ounces of zinc phosphide.

"The first year a city sewer system in our area is baited, we recommend baiting twice a year," Worcester remarked. "After that, once a year is normally sufficient. Manholes that are baited should be mapped."

Bird Repellents, Controls

Another U. S. Fish & Wildlife Service agent, William D. Fitzwater, Lafayette, Ind., brought delegates up-to-date on latest bird control measures — visual, acoustic, chemical, and mechanical repellents; and reductional controls.

In the field of inaudible sound frequencies, Fitzwater said basic research indicates pigeons have a hearing range of 200-7,500 cycles per second, sparrows 675-11,500 cycles per second, and starlings 700-15,000 cycles per second.

"Since man has a hearing range between 20-18,000 cycles per second, it seems doubtful that ultrasonics could be used as bird repellents," Fitzwater claimed. "However, literature points out what has been accomplished with high frequency sounds on rodents in the laboratory and there is hope for future technological advances that may be of value in bird control.

"Radio and radar waves also seem to offer possibilities in bird control. Reports indicate that radar may upset flight patterns of birds continually subjected to electromagnetic beams. This principle is used to some extent in the wiring of building ledges. Pulsating current through the wires creates an electromagnetic field several inches wide that keeps pigeons from roosting on the treated ledges."

In discussing mechanical repellents, Fitzwater said the use of a low-cost paper-fiber netting, which has given the horticulturists good protection against bird depredations on fruit crops, may some day prove practical for disrupting urban roosts.

For poisoning birds, Fitzwater said the PCO should first prebait with unpoisoned baits.

"For sparrows," he suggested, "use a corn:wheat mixture in the ratio of 3:1. Fine-cracked corn of a 1/8" particle size is most acceptable. Pigeons will also take a corn:wheat bait but the ratio should be about 5:1 and only whole or very coarsely-cracked corn should be used.

"Starlings are exceedingly difficult to bait. To date, our best success has been with a horse meat:bone meal bait, but this needs further investigation. Placement of baits on starling roosts has been a complete failure. However, promising results have been obtained by treatment of dumps and outlying farms,

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but the far-reaching effect of such procedures remains to be seen."

Suggested poisons for bird baits are strychnine alkaloid, strychnine sulfate, and thallium sulfate.

"These have secondary hazards which should be taken into consideration when the choice of a lethal method is being made," Fitzwater concluded.

Wildlife, PCO Safety

The hazards to wildlife that come with the use of these or other toxicants was pointed up by Howard Merrill, assistant chief of the Branch of Predator and Rodent Control, U. S. Fish & Wildlife Service, Washington, D. C.

In areas where large-scale chemical treatments are undertaken, Merrill said, there may be four effects on wildlife. The toxicants might cause (1) mortality among the resident wildlife population; (2) mortality among other animals which move into an area where the resident population has been depleted; (3) destruction of animal and plant life upon which many forms of wildlife depend for food; and (4) contamination of streams and ponds by run-off from treated areas. He said of the chemicals most frequently used, the chlorinated hydrocarbons seem to be the most critical. They were recently blamed for sterilizing 80% of the adult eagle population in Florida.

Safety also was the subject of John R. Beck, animal control biologist, USF&WLS, Columbus, O. He covered some of the more common diseases and parasites carried by birds and mammals which the PCO contacts and outlined preventive measures for treatment or control.

To protect himself from these diseases and parasites, the PCO, Beck said, should use such safety equipment as an air filter mask when he is exposed for a prolonged period to bird or bat dropping dust which contaminates the air; heavy gloves when handling live animals; rubber boots or gloves in damp or wet areas where rats occur; and washable or rubber gloves for handling dead animals.

PCO safety in the grounding of power tools was covered by B. A. McKenzie, agricultural engineer at Purdue. His remarks were similar to those in "Watch Your Ground!" which appeared in PC's January '59 issue, pg. 35.

James V. Shoaf of Central Service and Exterminating Co., Cleveland, O., spelled out the personal safety hazards in service work and the safety equipment needs of the PCO.

He recommended use of oil and acid resistant gloves; removable cotton liners that adsorb perspiration under the gloves; mist and dust respirators; goggles for overhead and outside spraying; protective ointments, such as "Kerodex 71:" first-aid kits containing certain basic items, such as an eye cup, a recommended eye wash solution, emetics, a universal antidote, and the usual antiseptics and bandages; and a fire extinguisher for termite crews.

In the wind-up session of the conference devoted to insecticides, Robert O. Boote of Orb Industries, Springfield, Pa., described aerosol insecticide con-

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tainers and how PCOs can use them effectively.

He said aerosol products available for use by the PCO include mainly **space sprays,** the bulk of which contain pyrethrins for quick knockdown; residual sprays containing either lindane, chlordane, malathion, dieldrin, etc.; mothproofers, such as Strobane, Perthane, or DDT; and deodorants.

How to retail these and other insecticides and equipment over-the-counter was covered by William K. Delaplane, Illini Pest Control and Service Co., Champaign, Ill.

"If you have a reasonably accessible **first-floor location,** you should **not overlook** the possibility of a **neat, well-organized** retail sales outlet, since it can be profitable and in slack years help keep your net profit up," Delaplane said.

"Our experience shows that a retail store does not compete with our service business, but helps increase it."

Products to be sold? Delaplane, whose offices are in Central Illinois, said 65% of his 1958 sales consisted of garden, lawn, and fruit tree insecticides; 22½%, household and garden sprayers and dusters, small tools, pet supplies, peat moss, and weed killers; 8%, lawn and garden fertilizers; and 4½%, oil formulations of dieldrin and chlordane for household use.

The characteristics and action of oil solutions, water emulsions, wettable powders, and dusts with which the PCO works were described by Howard Rosenbaum, Mercury Chemical Co., Chicago, Ill.

"An oil solution," he said, "has a low surface tension, flows into cracks and crevices with ease, is safer to use around electrical installations, is resistant to removal by wetting or washing, and will not freeze."

He added a note of warning: know which surfaces may be damaged by liquid and watch oil concentrates and oil solutions for signs of separation or precipitation after exposure to low temperatures.

"Never use an oil solution that has been left in a sprayer overnight at low temperatures without first warming it up to room temperature, and following this with agitation," he advised. "This will assure a homogeneous content."

Emulsions with a water base, Rosenbaum said, generally have less odor than oil solutions; and can be used around surfaces made of organic materials such as wall or floor tile which might be stained by oil base formulations; and can be used where there is any danger of flammability; and when a residual is needed on a very absorbent surface. Caution for possible staining was also advised.

He said wettable powders generally require a constant agitating system which will keep them in homogeneous suspension.

"They are comparable to emulsions in that they are used in a water base, but do lack long stability without agitation," he indicated. "They are extremely useful where sensitive varieties of vegetation are in danger of being sprayed and damaged or where it is desirable to maintain an insecticide residue on the surface with minimum penetration."

Dusts, he concluded, should be applied where they can be kept dry.

"They should be in relatively

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thin films which offer little resistance to movement of the insect," he said. "If they are applied heavily and offer any substantial resistance to the insect, they seem to be avoided."

Ira Hatfield, director of research for Wood Treating Chemicals Co., St. Louis, Mo., demonstrated the solvency of 50% odorless pentachlorophenol concentrate in nine different oil bases, using filter paper as the test surface. With the filter papers, he showed the evaporation and spreading qualities of such carriers as P-9 heavy oil, P-9 light oil, No. 2 fuel oil, No. 4 base oil, pine oil, No. 1 fuel oil, Dispersol, mineral spirits, and Xylene.

"The residual variations you can obtain from the same insecticide by changing the solvent shows why it is important for the PCO to know his chemicals and his solvents," Hatfield said. "The staining and odor problems of a solution are, as a rule, linked to the base oil."

The rapidity with which a solvent leaves the solution and volatilizes or evaporates determines the residual life of the insecticide, Hatfield said.

"In using water emulsions," he suggested, "it is necessary for a PCO to be certain of the quality of his emulsion in areas where there is a high ph content in tap water.

"A concentrate used in the wrong carrier and emulsifier combination will separate from the solvent and could leave the serviceman with his toxicant chemical concentrations either in the top or bottom of his spray tank, depending upon the formulation. This would give him good control in one series of rooms, but in others he would be spraying the carrier only and poor control would be realized."

For this reason, Hatfield recommended the PCO rely on chemical formulators who know the needs of this industry to do his mixing, rather than undertake the job himself just to save a few pennies a gallon on formulations.

"You'll save more money in callback reduction on jobs than can be made by formulating your own chemicals," Hatfield promised.

William Hazeltine, Agricultural Specialties, Dallas, Texas., reiterated the need for PCOs to know their formulations and solvents:

"The important thing to remember is that striking differences can exist with the same insecticide in different formulations. This indicates the need for individual evaluation of different preparations in control of any insect. Before you decide you have resistant insects because your formulation is not working, try several other formulations."

A special first day session on fundamental characteristics and control of insects was handled by Dr. John V. Osmun, chief of Purdue's Entomology Department; and staff members, Dr. B. E. Montgomery, Dr. Leland Chandler, Dr. H. O. Deay, R. C. Dobson, William Butts, C. E. McCoy, and J. K. Bready. Dr. Deay also conducted a hand-lens identification session as part of the roach program.

At the conference banquet, Dr. Osmun announced the 1960 Purdue PCO Conference will be held February 1-5. Program emphasis, he said, will probably be on lice, mites, ticks, and fleas.

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Weather may have been cold and bleak for much of this year's Eastern Conference, but that didn't keep delegates from posing for the annual group picture outdoors.

Highlight Ant Control at 19th Annual Eastern PCO Conference, Jan. 21-23

by ROBERT J. LAVIGNE
Department of Entomology and Plant Pathology, University of Massachusetts, Amherst

Ants were the main topic of interest for 137 industry members who gathered at the University of Massachusetts in Amherst, January 21-23 for the 19th annual Eastern PCO Conference, sponsored in cooperation with the National Pest Control Association.

During the two and one-half day meeting, panel discussions also included insecticides and miticides, pest animals, "pests and people," termites, control of resistant pests in Texas, and silica aerogels. A full day was set aside for lectures and demonstrations on the biology and control of ants, with special emphasis on carpenter ants and lawn ants.

"In controlling carpenter ants," Edward Maquire, W. A. Maquire and Co., Haverhill, Mass., said, "one of the most important things to keep in mind is where the housewife sees the ants. This gives some indication as to where you should start to work.

"These ants can be controlled with a 3% chlordane water emulsion, applied around foundation walls, tree stumps, sticky fruit trees, piled fire wood, cellars, and attics. When the insecticide is applied at the rate of 150 mg. per square foot, the surface treated should retain an active residue for 30-60 days. However, a 2% oil base solution should be applied on finished surfaces."

Philip Mayer, Jr., Evins Exterminating Co., Great Neck, N. Y., pointed out that pavement and corn field ants are the chief pests of lawns.

"On Long Island," Mayer claimed, "the recommended insecticide dosages usually do not give adequate ant control, consequently we must use 20 pounds of chlordane or 8 pounds of dieldrin per acre. These insecticides are diluted with 200-500 gallons of water per acre to prevent grass burn, then applied with a high pressure sprayer which puts out 35 gallons per minute.

"For this application, I charge $2 per 1,000 square feet, with a minimum of $12. With only one treatment, I guarantee control of lawn ants for one year. Application over an area of 12,000 square feet takes only 20 minutes when using 300 feet of hose and a John Bean Spraymaster Deluxe spraygun with an adjustable nozzle."

For general ant control, Dr. Philip Spear, NPCA technical director, said chlordane and dieldrin are probably the insecticides of choice.

"Take a good look at granules for ant control," Dr. Spear said, "especially for application in planting beds around houses for the control of pavement ants. The advantage of granules is their ease of handling. There are a number of grass seeders on the market which can be used to swirl out the insecticide or lay it in rows."

Although baits are on the way out for the most part, Dr. Spear continued, they can be used in tough problems such as sub-slab jobs where the PCO can't get at the ants. For a job of this nature, Dr. Spear recommended thallium sulphate. One formula: 1 pound of sugar, 3 ounces of honey, 1½ ounces of glycerine, 1 pint of water, and 2 grams of thallium sulphate.

"The sugar, honey, glycerine and half the water should be mixed together and boiled for five minutes," Dr. Spear said. "Boil longer for a thicker solution. Then mix 2 grams of thallium sulphate in a cup of hot water in a ventilated place. Mix two or three times while cooling and then add it to the sugar mixture. All mixing should be done in crockery or glass containers — never in metal containers. The finished mixture can be used as droplets on surfaces or in small poison bait cups.

Another suggested use of such an ant bait is in a small envelope tacked up on the wall. The thallium syrup can also be added to other materials such as cake, dried chopped liver, ground meat, bacon, peanut butter, and chocolate. This bait will retain its acceptability from 10 days to 2 weeks.

Thallium sulphate should not be used where there are children or pets, speakers emphasized.

New Chemicals Coming

Dr. Spear also commented on new chemicals for pest control.

As a possible insecticide for stored food products, he cited Barthrin, a chlorinated ester of chrysanthemumic acid, which is being developed by the U. S. Department of Agriculture. This material, he said, is a relative of pyrethrum, and its receptiveness to synergism should give a better total effect. This compound also appears to have some repellent properties.

In the field of fly baiting materials, Dr. Spear cited DDVP, an impurity in Dipterex, which has been slow in development due to a public patent.

"It is an organic phosphate stomach poison with an oral toxicity to rats of 50-80 mg./kg.," Dr. Spear remarked. "Due to its high volatility, it has been used as a 'fumigant,' but its general use in sweetened water is as a fly bait solution. Its effectiveness is gone within a couple of days.

"The U. S. Public Health Service recommends a formulation of 1/10% DDVP in water, with sugar added at the rate of 1

pound per gallon. Commercial formulations of DDVP in baits will be available soon," he predicted.

California Spray Chemical Co. has another new product — Dibrom, a bromide analogue of DDVP.

"Its changed properties as a result of the affixed bromine atoms bring its toxicity well below that of DDVP," Dr. Spear said. "Its oral toxicity to rats is 430 mg./kg. Extremely short lived and highly volatile, this compound is a contact killer which also works as a stomach poison. It will possibly be available for fly control this year."

Another group of materials which Dr. Spear said is "coming along" is the carbamates.

"One of these, Dimetilan, as yet unregistered is a Geigy Chemical Corp. product which may be used experimentally this year," he indicated. "Its similarity to parathion in toxicity limits its application to cords or sponges treated with this material and sugar and hung like fly cords."

Insectolac, a British varnish incorporating an insecticide for use in ships and buildings, is a newly registered product available from American Chemical and Ore Co., New York. The insecticide, he said, is largely retained in the lacquer with only small portions coming out from time to time. Although the material seems expensive when applied initially, the price would appear reasonable if the operator can get a year's control with it, Dr. Spear said.

Dieldrin is the only chemical which so far has been incorporated with this varnish, and German cockroaches are becoming resistant to this insecticide in many cases, thus limiting the usefulness of Insectolac.

Dri-Die 67, a chemically treated silica aerogel, was reviewed by Dr. Robert Norton, director of the Crop Protection Institute, Durham, N. H.

"Within the last three months," Dr. Norton said, "data have become available proving that this material will control roaches in commercial applications at rates of 8-16 ounces per 1,000 square feet. To give effective control, this material must make contact with the insect. Up to now, Dri-Die 67 has been used effectively to control drywood termites, most species of roaches, poultry lice, and dog ticks."

Resistance in Texas

The biggest problem in controlling resistant dog ticks is finding where the ticks are, Clayton Wright, C. Wright Associates, Dallas, Tex., told the conference.

In session at Amherst, left to right: Wayne K. Davis, Ailing House Termite Inspection Bureau, Oakland, Calif., NPCA president; Jacques J. Hess, Exterminating Services Corp., New York, N.Y.; Robert Troup, Harder Extermination Service, Inc., Hempstead, N.Y.; and Richard Keenan, Waltham Chemical Co., Waltham, Mass. The informality of panel discussions, typical of the Eastern PCO Conference, permits all PCOs to ask questions.

"Usually this is where the dog spends 85% of his time," Wright said. "For tick control, we use Del Nav, produced by Hercules Powder Co."

When treating for ticks in clapboard houses in Texas, Wright commented, the PCO can usually depend on retreating 10% of the time. Because the problem always boils down to dogs, Texas PCOs are setting up meetings in many areas of the state with local veterinarians to discuss mutual tick control problems.

When the problem is resistant fleas, Wright said it is advisable to double-treat bathrooms since fleas tend to congregate there.

"In treating any building or residence for resistant pests — particularly roaches," Wright concluded, "know the construction you're working with, and treat every crack and crevice immediately, before roaches have a chance to scatter. With the chemicals in use today, the PCO must spray every possible hiding place, or the roaches will move to the untreated areas."

In response to a question concerning the time it takes to get control of roaches, Wright answered that ½ hour to 5-10 days may be required for adequate control. He added that the two most commonly used chemicals in the South are sodium fluoride used as a dust and Diazinon as an emulsion. Dicapthon does not appear to be practical in Texas because of the high alkali content of the soil, he explained.

Before the PCO can cope with any resistance problem, he must know and understand the insect's ability to change its habits and adapt to various insecticides, Thomas Fisher, Residex Corp., Linden, N. J., said. To determine whether he is up against a resistant species, Fisher suggested, the PCO should (1) rule out the human factor by making certain his men are applying the chemicals properly, (2) re-apply an insecticide and check the results, and (3) test for resistance in the laboratory.

J. Byron Lovell, American Cyanamid Co., Stamford, Conn., covered the history of resistance in arthropods and said there are two possible approaches to control of resistant insects: (1) new compounds, or improvement of existing formulations to make them more readily absorbed by the insect, or (2) improvement in application techniques.

Termites, Bats, Birds

In the termite program, Dr. Spear enumerated the chemicals effective against termites, with special reference to the new Minimum Property Standards of the Federal Housing Administration (PC, Feb., pg. 9)

Bats also became a lively topic. Joseph Harris, Guarantee Exterminating Co., New York, N. Y., said as rabies vectors, bats have become an important problem, especially in New York, Ohio, Pennsylvania, and New Jersey.

For bat control, Harris suggested 50% DDT dust or ANTU dust applied to cracks and crevices in windows and walls, on rough timbers in attics, and on roosting spots.

"Roosting spots can be determined by observing the location of bat feces on the floor and shining a flashlight on the timbers above the spot," Harris noted. "The PCO should obtain 100% control in six weeks. Since bats clean themselves like cats, paradichlorobenzene crystals are also effective if the operator can get complete coverage."

Another health menace cited by Harris was the pigeon. He said it carries pneumonia virus, pigeon lice, and mites.

For the control of the Northern fowl mite which comes from bird nests, Professor Warren Whitcomb of the University of Massachusetts' Department of

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Entomology and Plant Pathology suggested DDT or 1% lindane. He added, however, that the only sure way of obtaining control was by destroying the source.

Rat Control, Day and Night

Moving over to rodent control, Joseph Harris said although the maximum breeding period for rats in the temperate zone is during the warm season, they will breed throughout the year in warm buildings, producing 3-12 litters per year. Harris pointed out that because rats are nocturnal in habit, sodium fluoroacetate baits are best applied at night, whereas Cyanogas is best used during the day when most rats are inside their burrows.

C. E. Faulkner, U. S. Fish and Wildlife Service district agent from Boston, said control of rats in the home should begin with trapping.

"In homes," he said, "we recommend the use of red squill or zinc phosphide mixed with cereal or ground bait. These cannot be carried off and quick kill results close to the bait station. This is especially desirable in commercial buildings.

Herman Ratner, Ratner Pest Control, Atlantic City, N. J., took exception to this idea.

"In my business," Ratner claimed, "I find trapping is not the right psychological approach. By using baits placed in the basement, crawl spaces, or other out-of-the-way sites, the householder is not apt to see the rats and will feel that he or she is getting good service. Moreover, anticoagulant baits are safe around children and pets as long as they are out of reach, but there is a distinct danger posed by the use of traps, especially to pets."

Faulkner added that anticoagulants could not be the complete answer, since both laboratory and field tests indicate that all four common anticoagulants — i.e., Pival, warfarin, Fumarin, and Diphacinone — have the same acceptability to rats, and none gives more than about 90% control due to inherent rat aversion.

"This situation is more common among roof rats than brown rats," Faulkner continued. "And mice have even more aversion to anticoagulant baits."

In baiting, Faulkner commented that a 1-19 ratio bait will take over 30 days to kill rats; a 1-9 ratio kills in 22 days.

For outside control around buildings, Faulkner recommended a perimeter defense of anticoagulant bait boxes after control has been achieved in the area. He suggested double compartment boxes with roofing paper attached to the top and bottom to create a serviceable all-weather container.

When treating open faced dumps for rodents, Faulkner said only one treatment a year is needed — in the fall just before the cold weather.

"For this," he said, "zinc phosphide combined with canned cat food and ground corn meal, to take up the moisture, is used. Use 9 pounds of canned fish and 1 pound of corn meal. Mix at the rate of 1 ounce of zinc phosphide to 4 pounds of canned fish and corn meal, along with ½% tartar emetic at a rate of 6 ounces per 100 pounds of prepared bait. This should give 90-95% control if applied to all burrows on the dump and around its edge.

"Dumps should be closed for

(Continued on page 66)

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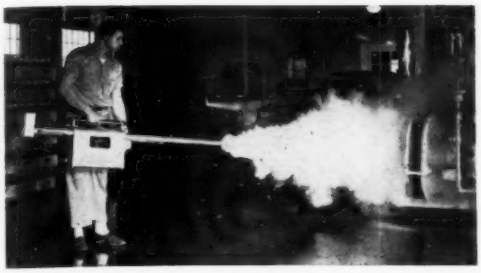

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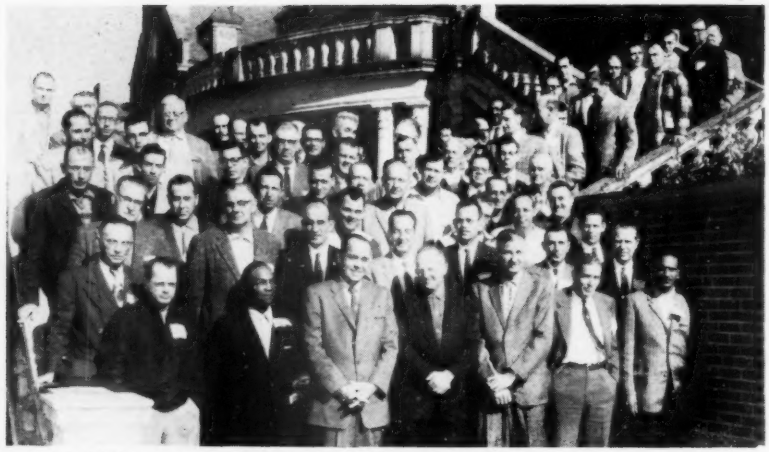

Oklahoma PCOA members at Oklahoma State University conference in January. General chairman of the 1959 meeting was Professor G. A. Bieberdorf of OSU's Department of Entomology.

Okla. PCOA Plans Safety Check for Organic Phosphate Exposure, Stillwater Conferees Learn

Simple tests in which a pest control operator can have the cholinesterase level in his blood checked following exposure to Diazinon, malathion, Korlan, or any other organic phosphate insecticide were described to about 90 members of the Oklahoma Pest Control Association at their ninth annual conference at Oklahoma State University in Stillwater January 22-23.

"The Oklahoma Association is setting up a program whereby its members will take these tests quarterly," Dr. R. Redmond of the Oklahoma University Medical School, Oklahoma City, said. "These tests are not readily available yet and require highly perishable chemical reagents, but details will be announced as soon as they are worked out."

In a closely related talk on pesticide safety, Dr. H. Shoemaker, chief of the Poison Information Center at the Oklahoma University Medical School, listed dangers, precautions, and emergency treatments the PCO should know when handling various types of toxicants.

Following a review of the present status of sorptive dusts and the outlook for future improvements, by Marshall Magner, Monsanto Chemical Co., St. Louis, Mo., Dr. D. E. Howell, head of Oklahoma State University's Department of Entomology, explained how an insecticide kills an insect (see Southern PCO Conference report, pg. 50).

The use of attractants and repellents in insecticides was covered by Dr. Carroll N. Smith, In Charge, Entomology Research Division, U. S. Department of Agriculture, Orlando, Fla. It was predicted the future combination of attractants or repellents with insecticides could give the PCO a "balanced team" to help him solve his resistance problems and expand the activities of the industry as a whole.

John Draper, Better Business Bureau representative from Oklahoma City, called attention to the already rapid growth of the industry, comparing it to a trip he recently made to New Mexico.

"There was the phenomenon of the mountains seeming to get smaller as we approached them," Draper said, "of our car engine laboring, of our speedometer registering low speeds although we were pressing down heavily upon the accelerator. Eventually we became worried enough to stop and investigate. Then, when we looked back over the road, we realized that what we thought had been a level road had actually climbed several thousand feet."

Draper said advances of the pest control industry in the last few years have produced the same phenomenon.

During the business session, Gayle Puryear, Antimite Service Co., Tulsa, was elected association president for 1959-60; James Craig, Craig Pest Control Co., Enid, vice president; and Tom Graham, Graham Pest Control and Garden Clinic, Oklahoma City, secretary-treasurer.

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Antics of hired "cousin" (at rostrum) kept Southern Conference banqueteers in stitches. Left to right at the speaker's table are: conference chairman, Clayton Wright, C. Wright Associates, Dallas; A. Blieden, Sanitation, Houston; Paul Adams, Adams Pest Control, Alexandria, La.; Lonnie Holder, Holder's Pest Control, Houston; Dr. Elmer P. Cheatum, chairman of Southern Methodist University's Biology Department; the lady Houston entertainer who kept the banquet crowd laughing; Dr. O. W. Rosewall, Department of Zoology and Entomology, Louisiana State University, Baton Rouge; NPCA president Wayne K. Davis, Ailing House Termite Inspection Bureau, Oakland, Calif.; Dr. Philip Spear, NPCA technical director; and Dr. Lee C. Truman (seated), Pest Control Services, Inc., Indianapolis, Ind. She came just to see "Cousin Wayne."

Focus on Dixie Pests at Southern PCO Conference in Dallas, Jan. 15-17

Insect, rodent, and reptile problems native to the South leaped into the spotlight at the 19th annual Southern Pest Control Operators' Conference January 15-17 in Dallas, Tex.

Sponsored by the National Pest Control Association, in cooperation with the Department of Biology at Southern Methodist University, sessions were held at the Adolphus Hotel in downtown Dallas the first two days and on the SMU campus outside the city on the last day. Total registration was 120.

During the on-campus segment of the program, the first half of the day was devoted to lab sessions. Dr. W. B. Davis, head of the Department of Wildlife Management at Texas A & M College, College Station, Tex., covered rodent identification; Dr. Elmer P. Cheatum, chairman of the SMU Biology Department, reviewed ant and black widow spider identification; and Dr. William B. Stallcup, Professor of Biology at SMU, handled reptile identification.

After learning how to recognize these pests conferees then received control tips.

"Sanitate" for Reptiles

For reptiles, Dr. Davis explained that very little can be done with chemicals, so chief emphasis is on sanitation.

"The first thing for the PCO to know is whether the snake he is up against should be controlled or not," Dr. Davis said. "If the snake is non-poisonous, very likely it is beneficial and its elimination thus might be a mistake.

"Most calls on snakes will come when a large community area is cleaned up or developed," Dr. Davis said. "When brush and debris is removed, you eliminate snake harborage and bring the snakes into the open. Without proper shelter, they'll likely move on."

To keep snakes out of an area, he suggested erection of fence or hardware cloth 18 inches high.

"Chemicals are usually ineffective against snakes unless there is an indirect poisoning action, as when poisoned insects are eaten by the snake. In the same light baits are usually unacceptable since most rattlesnakes feed on warm-blooded animals which they kill themselves. Water moccasins prefer cold-blooded animals, and coral snakes feed on other small snakes. And the covering of the snake is virtually impervious to any solution. So it all boils down to controlling the habitat."

However, one operator commented in a question and answer period that any type oil-base spray would bring a hard-to-find snake, which had moved into a home, out into the open.

If the operator traces a snake to its ground tunnel, Dr. Davis added, the PCO could gas the snake out by stuffing a cotton ball of carbon disulfide in the hole of the burrow, then plugging the hole. This ball of cotton could also be ignited, he said.

A midwest PCO stated he used an NPCA-recommended treatment of 50% DDT dust in the basement of a home infested by small garter snakes and the snakes disappeared. Dr. Davis indicated the action of the dust could be lethal, of course, or it could act as an irritant to drive the snakes away. Yet Dr. Philip Spear, technical director of the NPCA, commented that several PCOs in the North who had tried 50% DDT dust had reported occasional odor problems following treatment, pointing to a kill.

Another operator said 30 minutes after he had sprayed five rattlesnakes with a 10% pentachlorophenol solution in an oil base, they were dead. Dr. Davis observed that this could be due to the action of the oil and not the pentachlorophenol, since the oil might have penetrated the snake's skin.

South's Rodent Problems

Rodent control was covered at SMU by Charles Cadieux and Milton Caroline of the U. S. Fish and Wildlife Service, San Antonio. Caroline commented on the cotton rat and nutria, and Cadieux on other "wild animal" nuisances.

"To eliminate the skunk, it isn't always necessary to kill him," Cadieux said. "You can often evict one with a counter-offensive odor — moth crystals or naphtha flakes, scattered in their den. But be sure to leave an escape route for them at night, then seal it tightly after they have left.

"If the hole opens out onto dusty soil or moist earth, tracks will be easily apparent to help you determine that the skunk has left. If no tracking material is present, make your own by sifting flour on the surface outside the opening. Faster eviction can be accomplished through the use of a gas such as chlorpicrin, but there's a danger of killing the animal, which could create a later odor problem."

The death of small animals is best accomplished with strychnine-treated eggs, Cadieux said. The poison is dissolved in hot water, then stirred into a glycerine mixture, and injected into the egg with a small hypodermic needle. A solution of 1 ounce of strychnine to 8 ounces of glycerine and 8 ounces of water does the job "quickly and neatly," he said. As an added safety factor, Cadieux also suggested the addition of green coloring to the solution so the egg would appear less edible to humans if it were broken.

Cadieux cautioned, however, that an occasional dog may try to suck the eggs, so they should be placed well back in the dens and runways, and uneaten eggs should be removed.

"As another safety precaution for humans, every poisoned egg ought to be marked plainly with the word 'poison' in a color crayon or grease pencil, no matter

how well the egg is concealed," Cadieux remarked. "This will not reduce acceptance.

"Where raccoons are concerned, the use of honey rather than glycerine produces more complete acceptance and a dead animal in plain sight," he said. "Eggs are attractive to almost any rodent that wears fur."

"Where they may be legally poisoned, a 2-inch length of sweet corn, liberally coated with strychnine, can be stuck on top of a sharp stick and then covered with wax paper loosely tied about the stake. This strychnine paste is made by boiling ½ ounce of laundry starch in ¾ pint of water.

"When the mixture is stirred enough to be free of lumps, stir in ¼ pint of corn syrup, ½ ounce of glycerine, and 1 ounce of strychnine alkaloid. Add 1 ounce of baking soda. This mixture is sufficiently concentrated to do the job and will adhere readily to the corn used as bait."

The wax paper, Cadieux explained, will attract the curious coon, which is the only animal he believes capable of removing the paper and getting to the bait. This method was recommended where domestic fowl might be endangered by corn baits. The small size of the bait insures it will all be eaten by the coon.

For rabbit control, he suggested strychnine alkaloid paste in 10% solution, smeared on ears of corn. Where strychnine ear corn is not accepted, try zinc phosphide carrots, he recommended. In using repellents on trees to stop rabbit damage, Cadieux warned that some chemicals have removed the bark, as well as the rabbits. A heavy rain also will lower the repellent's effectiveness.

Cadieux indicated many of the chlorinated hydrocarbons show "promise" for rodent control, but said USF&WLS recommendations on them would be held up until further field testing and research have been completed.

In his brief talk, the USF&WLS's Milton Caroline said the current cotton rat eruption in the Southwest is expected to end before next summer.

Caroline provided a control suggestion for nutrias, fur-bearing pests originally introduced into this country several years ago to clean up vegetation on lakes. To make 1-ounce baits, he said put 6 pounds of sweet potato or 6 pounds of carrot in a bucket, sprinkle 1% zinc phosphide on top, then add a cupful of oil so the bait has an "oily" appearance. Baits should then be placed along nutria trails where they enter the water. Baiting should not be heavier than necessary since the zinc phosphide might kill some birds. Other methods of control for them are shooting or trapping, he indicated. Nutrias usually will not invade a building, are mostly vegetarian in their eating habits.

Fire Ant Flame-Up

Ant control — chiefly for the imported fire ant—was discussed by G. L. Edwards, Redd Pest Control, Jackson, Miss.

On commercial ant control jobs in his area, he said he has achieved best control with 5% dieldrin granules on infested acreage. Quicker control can be obtained, he said, if the operator will also put liquid dieldrin or granules in the fire ant mound itself.

"We now include fire ant protection in our regular household pest control contracts," Edwards told the conference. "This treatment, applied under the house and on the yard, also takes care of other ground-nesting ants, but it does kill all soil insects, good or bad."

Ornamental Pests

In the technical sessions back at the hotel, insects which infest ornamental plants and shrubs in the South were identified and their control summarized by C. F. Garner, extension entomologist at Texas A & M College, College Station, Tex.

"It's difficult for the PCO not to have an interest in this market since it ties in so closely with household pest control," Garner said. "When you treat a home for roaches or ants, the home owner may very well ask you about insects on the lawn or in the shrubbery. If you don't get this business, your competitor may. And once the competitor does, he'll be in a position, as well, to bargain for the household pest control account you have with that customer."

"Never spray flowers or plants with tender tissues when they are in a wilted condition or when the temperature is about 85-90°," Garner cautioned. "They should be watered first, then sprayed unless the air is too hot. That's why dusts and wettable powders are generally safer for this type of application around the home than oil emulsion concentrates, since the latter carries oil that could burn the plant."

Garner added that some plants, such as the redbud tree, are sensitive to certain sprays. To be safe, he suggested the operator who is uncertain about the sensitivity of the tree or plant he is to treat, pick a small test area first and apply his chemical there before proceeding with a more generalized application. Once he observes the reaction of the plant to this test dosage, he will know whether to carry on with the treatment or seek alternate chemicals.

Sprays for Bird Control

George Hockenyos, Sentinel Laboratories, Springfield, Ill., covered another growing market for PCOs — bird control — and new areas of research for this field. He said good control of starlings can be obtained with 4% endrin sprays where the starlings will not accept 10% endrin baits, but some type of repellent is needed in the formulation to prevent secondary poisoning of cats and dogs. He remarked that nicotine will repel these two pets. However, the cost of nicotine for this purpose would be almost prohibitive, he said.

Hockenyos cited an example to show how serious, and some-

In ant and spider lab identification session of SMU's Dr. Elmer Cheatum, facing camera with arms crossed, Southern Conference delegates not only observed ants and spiders under magnification, but had a chance to examine special, plastic mounted insect specimens. These were fashioned at SMU by the university's Andrew Couch, Jr., preparator and curator of the Biology Department, who explained in detail how they are made.

times unavoidable, secondary poisoning can be.

"A farmer for whom we'd done some termite work complained that thousands of starlings were feeding in his cattle and hog trough, and actually were eating more than all his cattle. He couldn't even keep them out with burlap coverings over the door. Finally when bird droppings caused dysentery in several of his hogs and they died, the farmer became almost desperate. He asked us what to do, and we suggested he construct a trough above the cattle and hog feeding station and pre-bait it for three or four days with the black molasses pellets which had originally attracted the birds into the ground-level trough.

"Then we treated 25 pounds of pellets with 1080, and he put them in the trough on top of the shed for the birds. I warned him of the secondary poisoning hazard, but he was convinced he and his two boys could gather up all the fallen birds before they could be eaten by any of the farm pets. An hour after feeding on the poisoned bait, however, the birds rained down so heavily that the farmer and his boys couldn't pick them all up fast enough, and he lost two cats, one dog, and two hogs. But he still figures it was worth it."

Another area of research which Hockenyos wants explored is the use of cold water for starling control. He believes starlings are sensitive enough that cold water sprayed on them during cold weather would be enough of a shock to their system to kill them. He says he has not been able to experiment in his laboratory on this idea, since starlings cannot be kept alive in captivity for over one or two days.

"Birth control" or nest destruction, likewise, has its possibilities. By destroying favorable nesting sites in the winter, the birds must move out into the cold, where the low temperatures will bring a higher mortality of the young. To get the birds out of their warm roosts one might use repellents, scares, or construction repairs.

Another future control method may be "bird traps." By using bird decoys and simulating ideal nest or roost conditions with warmth and light, Hockenyos says starlings can be attracted into a nesting trap, imprisoned, then gassed. He said he helped construct a successful trap of this nature at the Illinois Fairgrounds as an experiment.

Previews CDC '59 Fly Report

Research in fly control was the topic of Dr. R. W. Fay of the Biology Section, Communicable Disease Center, Savannah, Ga. He traced the history of house fly resistance and described results of CDC fly control field studies during 1958. His talk was based on the "Fly Control" section of the CDC "Public Health Pesticides" report, which begins on page 9 of this issue.

Killing Action of Insecticides

How insecticides kill and the relationship of insect morphology-physiology to their toxic action was described by Dr. D. E. Howell. head of the Department of Entomology, Oklahoma State University, Stillwater.

The insect's body wall, Dr. Howell indicated, is divided into four layers: the epicuticula, composed of fatty materials which form lipids or waxy substances

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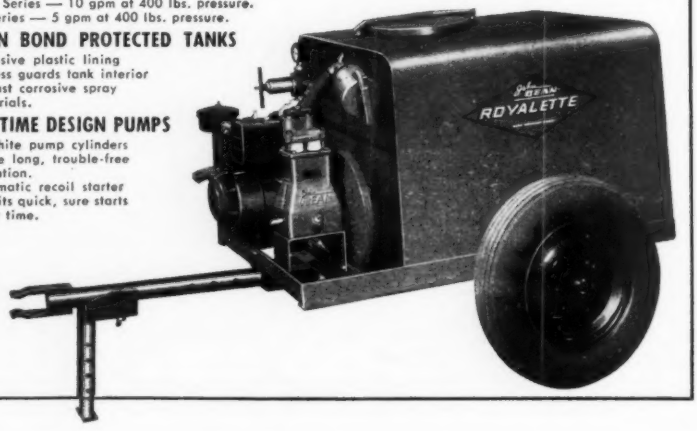

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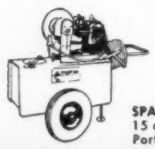

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☐ Facts on Dutch Elm Disease Control

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on the surface of the insect body; exocuticula, composed of proteins in a hard rigid form; the endocuticula, consisting of a softer material; and cells. The epicuticula prevents loss of water, the exocuticula gives the insect body strength, and the endocuticula is for waste storage, muscle attachment, and many other physiological functions. Dr. Howell explained that the most important avenues for entry of the insecticide into the insect body are the sensory hair "sockets" and similar thin areas of the body wall.

"No one knows for certain exactly how DDT kills," Dr. Howell remarked, "but it's believed that the insecticide penetrates the epicuticula, then migrates on through the endocuticula and into the nerve tract. There it interferes with nerve transmission, and the stimuli once started in the insect body cannot be stopped. So the insect literally works itself to death.

"Arsenicals, on the other hand, kill the insect by breaking down its body cells and interfering with its respiratory responses."

Dr. Howell said the organic phosphates destroy the cholinesterase balance of the insect, which is essential for nerve transmission. Fumigants, he added, are taken in mainly through the insect breathing system, and destroy the ability of the insect's body to function normally due to their action upon the insect's enzyme systems.

"Silica dusts are abrasive and scratch the waxy epicuticula or protective layer of the insect," he related. "This results in water loss, and the insect dries up or dehydrates.

"The PCO must know insect morphology and physiology to know how best to apply his insecticides. He should use materials that will wet the body of the insect and stick to its surface, so oil or kerosene may be the choice.

"A smooth coating of insecticide in an area may not kill the roach since it might run right over it without picking up particles which would otherwise cling to its body and be absorbed. When the roach runs through a dust film, however, he may clean one of his legs with his mouth and thus take the insecticide internally and be poisoned.

"In the same way, if you are dealing with an insect which has a hairy body, such as some ants, a dust may not penetrate the hair to reach the insect body. When using a fumigant, low concentrations may close the insect spiracles and thus reduce kill by preventing entrance of the gas into the body."

Dr. Howell said in a question and answer period that certain insecticides used in combination, such as pyrethrum and piperonyl butoxide, complement each other. Yet others, like the isomers of benzene hexachloride, would have an action independent of and antagonistic to the other and would thus neutralize control results.

Diazinon and chlordane, used together, he concluded, would give quick kill, but if the insect is developing immunity to these two, resistance would increase that much more rapidly with its exposure to the two chemicals in combination.

TOs on Certification Board

In the termite control portion of the program, Dr. Ralph E. Heal, executive secretary of the NPCA, reviewed the new Mini-

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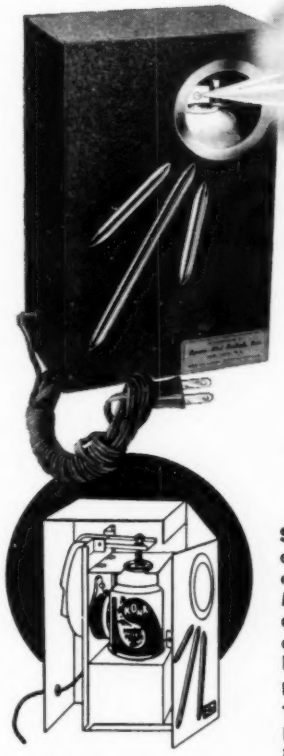

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mum Property Standards of the Federal Housing Administration (PC,Feb. '59, pg. 9) and progress of the NPCA effort to obtain certification for members doing soil pretreatment work.

He announced the four industry members elected to serve on the NPCA Board of Certification for Preconstruction Termite Treatment are Myron Smith, Hill-Smith Systems, Memphis, Tenn.; Paul Adams, Adams Pest Control, Alexandria, La.; Dr. Lee Truman, Pest Control Services, Inc., Indianapolis, Ind.; and J. Wilfred Gunn, Hollywood Termite Control, Los Angeles, Calif. On the Board with these four will be three other members of allied industries.

Professor Cecil H. Smith of SMU's Department of Civil Engineering, reviewed problems of soil changes and characteristics that affect termite chemical movement in soil. (The second part of a three-part article on this subject begins on page 57 of this issue.)

"Since many seemingly dry clay soils may still be essentially saturated," Professor Smith said, "an oil type treatment is doomed to failure unless some manipulation and mixing with the soil is involved.

"Yet use of a water soluble or water carrier treatment in the manipulation process, which may satisfy the 'thirst' of the soil at the beginning, will leave the soil ready for later shrinkage if there is a drying tendency. There will also be a leaching action if the chemical is water soluble."

For best results in chemical application of clay soil, Professor Smith said the operator needs a non-saturated soil to achieve any appreciable volume of absorption. This may involve some positive method of drying out the soil before injection. A solution rather than a suspension should be used, he advised, since most of the suspended matter would be strained out close to the point of injection. In damp soils, the operator should inject his chemical slowly for maximum penetration and absorption.

For treatment of sands, Professor Smith said that unless the foundation is virtually "floating" in water, any formulation can be used except the coarsest suspensions.

"The only factor to be considered is the more rapid leaching of water soluble chemicals if the sand is strong enough to make capillary contact between the surface and a water source," he observed. "The best treatment would be a non-water soluble material such as an oil emulsion which will penetrate easily and stay in place to control termites."

Slides of termites and other insects, as well as various booklets, training aids and promotional displays available from the NPCA, were shown to conferees by Dr. Philip Spear, NPCA technical director.

Calls for Uniform Accounts

Opening the business segment of the conference was a talk by Fred New, Ragan Exterminators, Inc., Kansas City, Mo., on details of the NPCA's new uniform account classification program adopted by members at the National's convention in Washington last October (PC, Nov. '58, pg. 20). This accounting tool is designed to standardize members' bookkeeping practices for comparative cost control and analysis.

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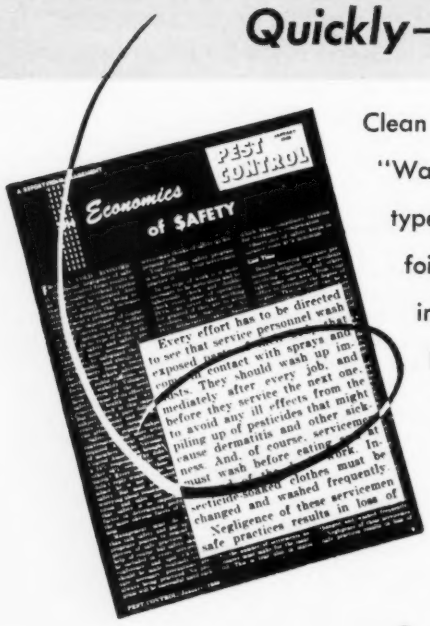

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Dr. Lee Truman, Pest Control Services, Inc., Indianapolis, Ind., underlined the need for such a uniform account classification, said the NPCA's breakdown of expense items was almost identical to the one he has been using in his office for years. To maintain accounts under this system or whichever system the PCO uses, Dr. Truman said every PCO needs a Certified Public Accountant.

Along with proper accounting practices, Dr. Truman listed five other chief areas of a PCO's business which mold his profit: public relations, advertising, sales, pricing, and service.

"One of the most productive forms of public relations is membership in civic groups." Dr. Truman commented. "Whenever I attend a club meeting or luncheon, the center of attention at my particular table always seems to shift to pest control. After all, this is an unusual occupation, and everyone's interested in it because at one time or another they've encountered insect pests. In two small clubs to which I belong, I spend less than $150 a year, yet their members account for over $7,000 worth of business. And this is without any solicitations."

How important is P-R on the part of the servicemen? To check this, Dr. Truman said he once listed all of his company's accounts and had each serviceman write in the name of the client for the particular accounts which he serviced. Result: only 47% of the servicemen knew the first or last name of the customers they handled. The next month, Dr. Truman checked his men again on this, found that 96% knew their customer's name. In that same month, his cancellation rate dropped 50%.

For servicemen that also do some selling, Dr. Truman said definite hours should be set aside for the two jobs of selling and servicing. He remarked that if a PCO gives his serviceman $500 worth of servicing to do in the mornings and leaves afternoons free for selling there is no excuse for throwing another $300 worth of servicing on the man to be certain he's producing.

"Don't underestimate the importance of those sales calls by your servicemen," Dr. Truman stressed. "If a man approaches enough prospects, he will have to sell a certain volume of business. It all evens out over a period."

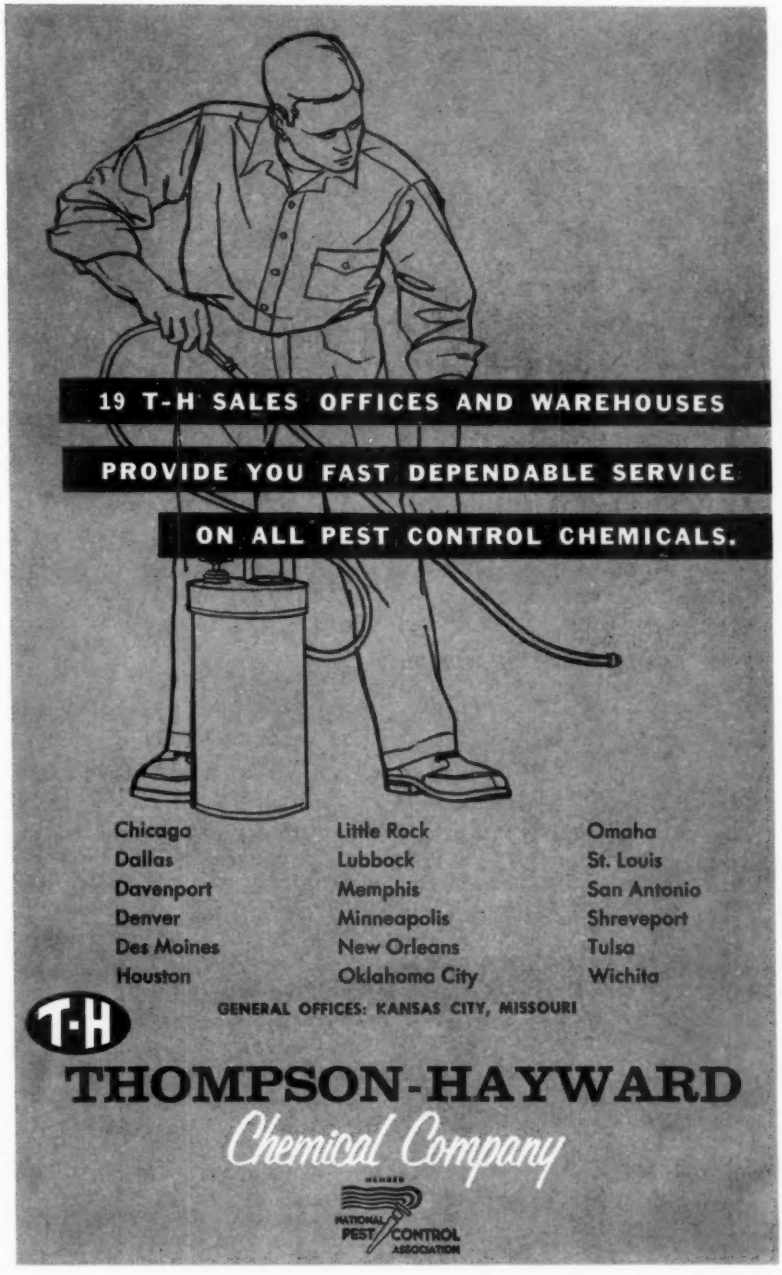
Dr. Truman cited the case of a new pest control salesman who made 67 calls and didn't get a sale, was about ready to quit. Yet, persuaded to continue, he made 33 sales by the time he reached 100 calls — or an average of one out of three for the first 100 stops.

"If we could count on one extra sale in every 10 calls, we could double our business," Dr. Truman said. "The big mistake so many PCOs make is their failure to properly train their servicemen for selling, getting them to develop a discipline and an interest in sales.

"When your serviceman goes out on his service route, prepare a list from the city directory of all prospects in the immediate area he'll be servicing, and have him visit with these people if he has an extra hour or two in the afternoon."

When should sales calls be made? Dr. Truman said some of the best months he's found are

(Continued on page 66)



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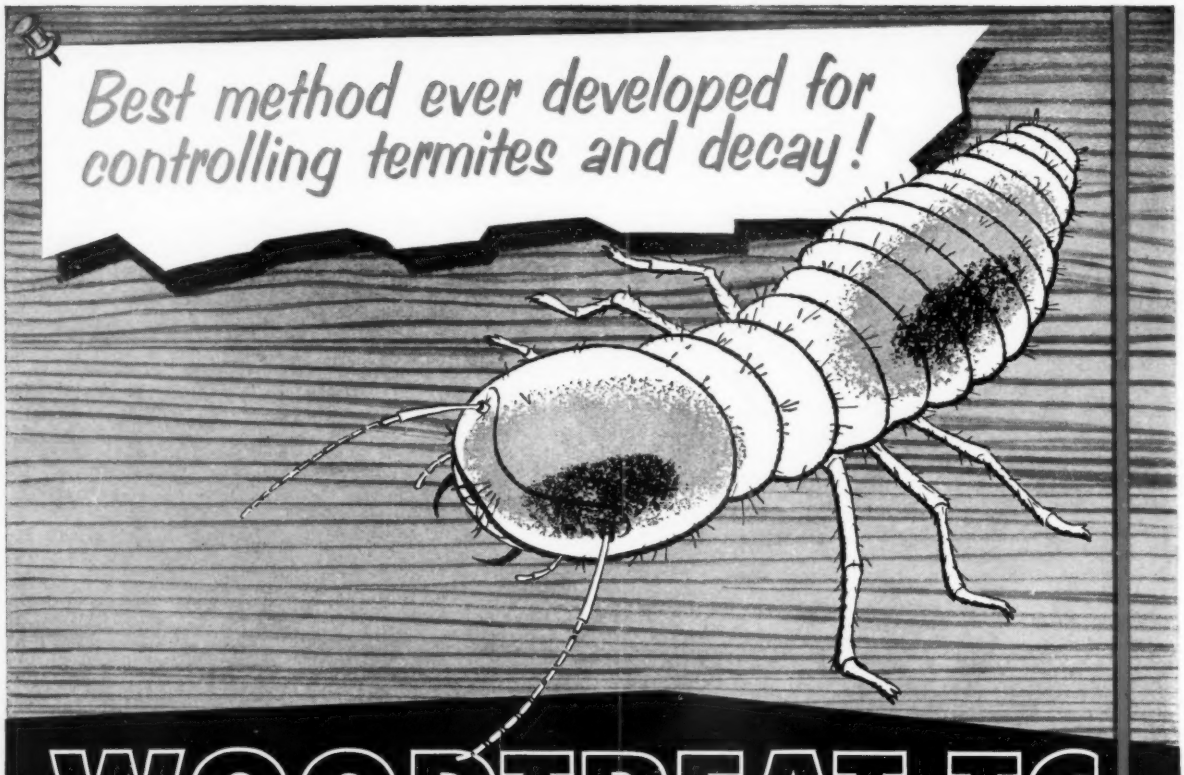

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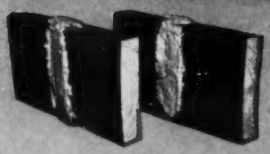

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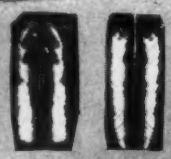
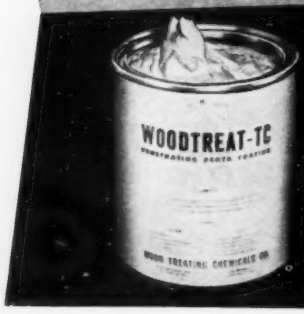


4 days later. Cross sections of boards at point of application. Penta has made almost complete penetration.



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Soil Conditions and Termite Control PART TWO — Chemical Application, Structural Safeguards

by J. V. PARCHER and R. E. MEANS

Associate Professor of Civil Engineering — Professor of Architecture
Oklahoma State University, Stillwater

In general, it is believed control of subterranean termites can be accomplished in either of two ways: (1) treatment of the soil to render it uninhabitable by termites or (2) use of construction procedures which will positively and permanently deny termites access to food. The latter, although much to be desired, is difficult to achieve with absolute certainty. Logically, then, it would seem that pre-construction treatment of the soil, coupled with the adoption of proper construction procedures, would constitute the best practice in areas where termites exist.

Treatment of Soil

Soil is commonly treated with a toxic chemical carried in solution, in suspension, or as an emulsion. These liquids may be allowed to soak into the ground under low head,[1] as from a shallow trench, or they may be injected under rather high pressures from a perforated tube. Various problems which arise cannot, in this article, be given the detailed treatment they deserve, but their solution will depend upon interrelationships between properties of the fluid and properties of the soil. Viscosity of the solution or emulsion will be nearly the same as that of the carrying liquid, either oil or water.

Soaking of the Soil. If soil to be treated is already saturated, the rate at which the water emulsion will be forced into the soil by "ponding" the surface may be very slow. The following table gives an idea of the time required for penetration of a layer of saturated soil one foot thick.

Coarse Sand	30 minutes
Fine Sand	2 days
Silt	20 days
Sandy or Silty Clay	6 months
Fat Clay	several years

These times will be greatly reduced if the emulsion is applied to a dry soil, particularly in the case of finer grained soils. This is due to the fact that the fluid will be drawn into the pores by capillarity. Magnitude of the capillary "pull" depends upon size of pore openings — increasing with decreasing pore diameter. In the case of coarse sand, rate of advance will be about the same in dry soil as in saturated soil. But for fat clays, rate of advance will be many times faster in dry soil due to the extremely high capillary forces. Nevertheless, a very long time will be required for treatment of clay. Even after saturation, the emulsion will continue to be drawn into pores for a long time as the clay slowly swells.

It was explained in Part 1 of this series (Jan. '59) that a layer of pore water is immobilized around each grain of clay. This reduces pore size and, therefore, permeability. Since the same phenomenon does not occur with oil in the pores, it is possible that treatment can be accelerated somewhat, for dry clays, by use of oil rather than water as the carrier. However, advantage of the increased effective pore size is likely to be largely offset by increased viscosity of the fluid.

Pressure Injection. Treatment of soil by injection of the emulsion under pressure is generally accomplished through a perforated tube jetted[2] into position. If the injection tube is properly sealed in its hole, use of pressure will certainly increase the rate of percolation through all soils, either dry or saturated. Nevertheless, in fat clays, treatment will still proceed so slowly as to be usually impracticable. As a matter of fact, dry clays are likely to take up the emulsion almost as rapidly by soaking (due to high capillary pull) as when subjected to pressure treatment.

Some precautionary remarks must be made regarding pressure injection procedures. When a tube is jetted into position prior to treatment of inaccessible areas, soil structure will be affected. Cohesionless soils tend to become looser and, if high jetting pressures are used, piping (or washing out) of the soil may occur either through the jetted hole or at some point on the surface of the ground. A considerable loss of soil can take place in this manner and could result in serious damage to the supported building. In clay, cavities may be produced with equally serious consequences. In treating pervious soils such as gravel and sand, high pressures should not be required to produce rapid penetration of the emulsion. In fine silts and clays, rapid penetration simply cannot be achieved. High rates of flow or sudden increases in flow will probably indicate a rupture through to the surface, making effectual treatment impossible.

Conclusions. Treatment of coarse-grained cohesionless soils can probably be done effectively either by soaking or by injection under low pressure. Fine grained soils (especially clays) probably can **not** be effectively treated over large areas, either by soaking or by pressure injection. A mechanical mixing of the soil (in a fairly dry condition) [3] with the insecticide emulsion would seem to of-

1. The term "head" refers to the height of a column of water. For example, the head which forces water from a faucet is equal to the difference in elevation of the water surface in the standpipe and that of the faucet (if frictional losses in the pipe are neglected). The "pressure" itself is equal to the "head" multiplied by the unit weight of water. Thus, a head of about 33 feet of water produces a pressure of about 15 pounds per square inch.

2. When a tube is "jetted" into position, the authors mean simply that water is forced from the tube under pressure in such a way as to displace the soil from the path of the tube — that is, the tube virtually digs its own hole. This method is often used since it is simpler than driving the tube with a hammer or preboring a hole for the tube.

3. "Mechanical mixing of the soil" means that the soil is broken up and mixed with the emulsion, using shovels, hoes, rakes, or similar equipment. On a large job, machinery could be used for this.

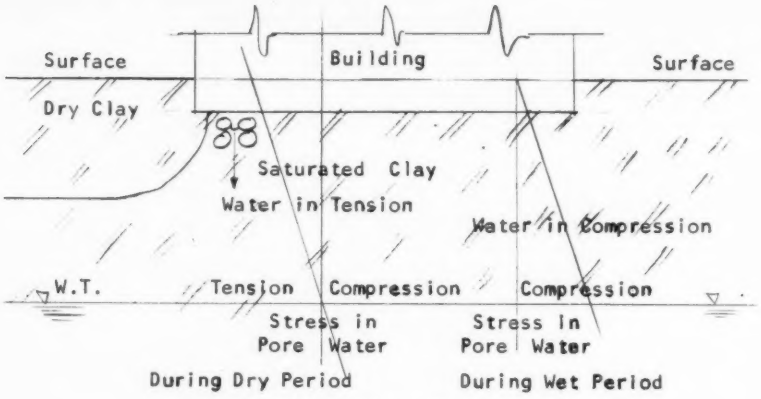

Fig. 7. Effect of building on water content of clay.

fer the best possibility. Limited areas, such as in trenches around foundation walls, may possibly receive adequate treatment by soaking. This will be improved by loosening the soil in the trench to the desired depth of treatment. For soils given adequate initial treatment, effectiveness will probably persist for a longer time in the fine-grained soils. Fluctuations of the water table and percolation of surface water will, in the case of coarse-grained soils, result in rapid loss or progressive dilution of the chemical emulsion.

One final question needs to be raised, though it cannot, at present, be precisely answered. Are suspended particles in an emulsion likely to be filtered out by the soil being treated? This can almost certainly be answered in the negative for all soils except clays. Size of the suspended particles (oil droplets) in an O/W[4] emulsion is likely to be about the same as the diameter of the pores in clay. There is then the possibility (which needs further investigation) that these particles will be retained near the surface of entry.

Construction Procedures

Many desirable construction procedures, such as use of treated lumber, vapor barriers, mechanical termite shields, etc., are related only indirectly, if at all, to soil conditions. These will not be discussed here. Where concrete is used as a physical barrier against termites, as in grade beams, foundation walls, pier caps, and slabs-on-ground, construction procedures should be designed to prevent formation of any continuous cracks larger than about 1/64th inch through the concrete. For properly proportioned footings this requirement usually presents no difficulty in the case of cohesionless soils. Let us turn, then, to the problem of construction on clay.

Foundations on Clay. For properly designed foundations, no serious trouble is likely to develop as a result of consolidation of the soil under load. Major problems which arise are associated with volume changes which accompany changes in water content of the clay. This problem is most serious in semi-arid southwestern regions of the United States where overconsolidated surface deposits may alternately dry out to depths of nearly 15 feet during time of drought and become saturated during extended wet spells.

When a building is built over an area of dry clay, evaporation is retarded and capillary water rises through the soil from the water table. If the floor slab rests on the ground, capillary water will eventually saturate the soil to the bottom of the slab, as shown in **Figure 7.** The clay will then begin to swell as much as it can against the weight of the capillary water and the floor load. As soon as surface water is applied to the clay, weight of the capillary water is removed by changing the tension in the water to compression, as shown in **Figure 7.** The clay can then begin to swell against the lighter pressure of the floor load only. This swelling, which is rapid at first, gradually slows down but continues for several years. Once the clay under interior parts of the building has become wet, it remains so, and the clay does not shrink again.

Moisture content of soil under shallow exterior footings will vary with seasons. This results in a periodic vertical movement of these footings as the soil alternately shrinks and swells. Lightly loaded interior footings, on the other hand, are lifted as the soil becomes saturated and thereafter remain stable. **Figure 8** illustrates typical damage due to this action. Occasionally broad, continuous footings will rotate due to greater drying of the soil under the outside edge. Damage of the type shown in **Figure 9** may then result.

Perhaps of more serious concern from the standpoint of ter-

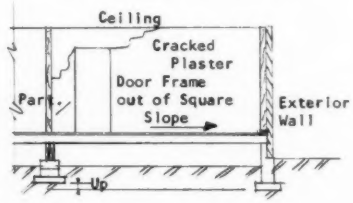

Fig. 8. Section through house.

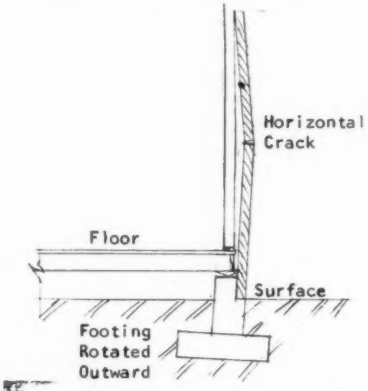

Fig. 9. Section through exterior wall.

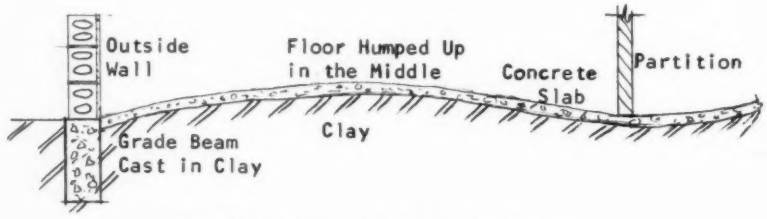

Fig. 10. Section through beam and slab on earth.

4. O/W stands for oil/water. This is a type of emulsion in which tiny drops of oil are carried in suspension in water. The oil droplets, in this case, carry the insecticide.

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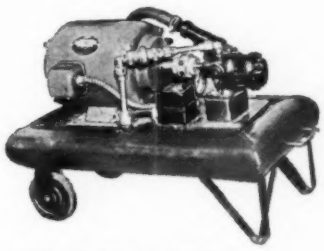

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mite control is behavior of slabs placed on dry soil. For reasons indicated above, these slabs are lifted higher and more rapidly at interior points where the slab supports no load, as represented in **Figure 10.** Slabs are almost certain to be damaged, with cracks often opening to widths in excess of ¼ inch. In addition, partitions may be severely damaged and, exceptionally, exterior masonry walls have been lifted free of the grade beam in the vicinity of cross-partitions.

Obviously, damage of the type mentioned above will make the structure susceptible to the inroads of termites. Therefore, construction procedures in every community should be in accordance with the best practices. These are determined by competent advice, by experience, and by the use of sound judgment.

(The concluding installment of this three-part series, scheduled for next month, will cover identification and classification of soils. — Ed.)

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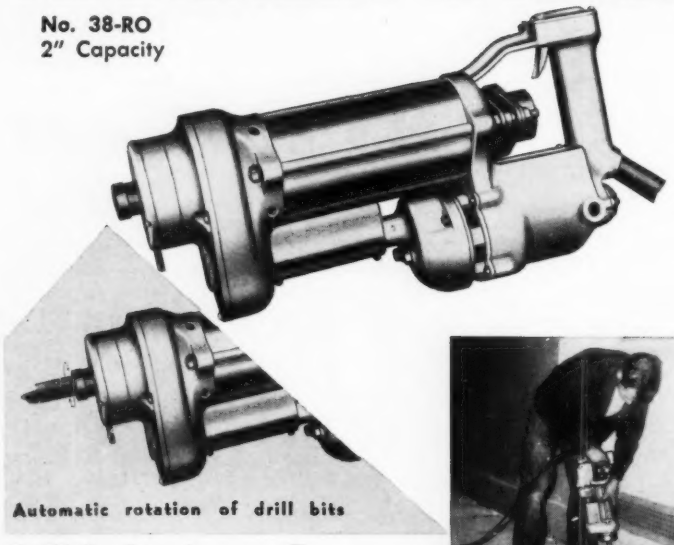

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Available in models ranging from ⅜ inch to 2 inch capacities. Write for complete details. PC359

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Termites in "Changing Times"

The February '59 issue of The Kiplinger Magazine "Changing Times" (pgs. 17-19) carries an article discussing the termite menace in this country. Do-it-yourselfers are discouraged and PCO services recommended in five paragraphs of the story. It says in part:

"Do-it-yourself control . . . is not particularly recommended . . . In almost every community there are qualified professional pest control operators who can do better and safer work. They have specialized equipment, and they have both experience and knowledge in the ways of the wily termite."

Mason to HHFA Post

Norman P. Mason, formerly Commissioner of the Federal Housing Administration, has been appointed Administrator of the Housing and Home Finance Agency. He replaces Albert M. Cole, who is now with Reynolds Aluminum Service Corp., Washington, D. C. The new FHA Commissioner is Julian Zimmerman.

Dowell Plugs by Superior

Hard rock maple dowell plugs that can be painted or stained to match the wood in which they are used are available from Superior Chemical Products, Inc., 47 North 2nd St., Philadelphia 6, Pa.

They are available in four diameters — from ¼" to ¾", and in two lengths, ½" and 1" — can be purchased either straight, or tapered at one end to facilitate insertion. For more information, write Superior Chemical Products.

Dillon Named BRAB Head

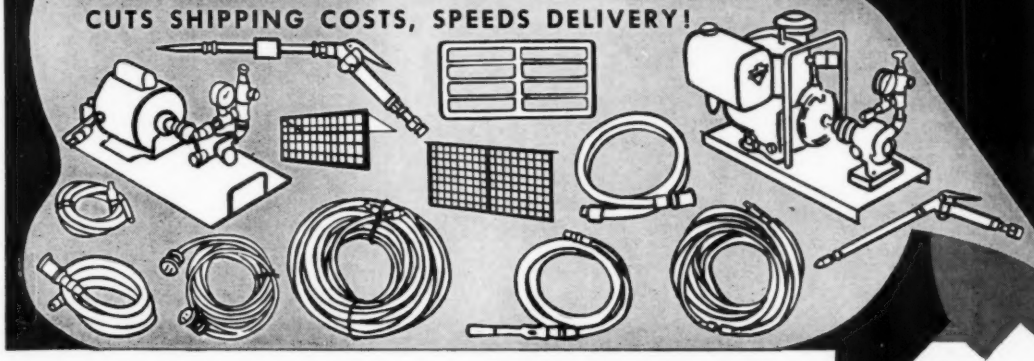
Robert M. Dillon, a staff member of the Building Research Advisory Board for several years, has been appointed BRAB's executive director, according to the National Academy of Sciences, National Research Council.

Verble Is Arab Sales Chief

Carl E. Verble has been appointed sales manager of Arab Termite and Pest Control Co., Indianapolis, Ind. Verble was formerly with Radio Corporation of America.

Make Associated Sales & Supply Your Headquarters for all Termite Control Needs

ONE STOP SERVICE SUPPLIES ALL YOUR NEEDS
CUTS SHIPPING COSTS, SPEEDS DELIVERY!



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1/4 - 6	1.33	3.33	3.67
9/32 - 4	1.33	3.33	3.67
9/32 - 6	1.33	3.33	3.67
5/16 - 4	1.40	4.00	4.34
5/16 - 6	1.40	4.00	4.34
3/8 - 4	1.53	4.40	4.74
3/8 - 6	1.53	4.40	4.74
7/16 - 4	1.73	4.54	4.87
1/2 - 1/4 Sk	2.00	4.67	5.00
1/2 - 3/8 Sk	2.00	4.67	5.00
5/8 - 6	2.40	5.34	5.67
3/4 - 6	3.07	5.54	5.87
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1 - 6	5.34	6.67	7.00

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What's NEWS In The Industry

AMCA Plans An "Operations" Accent at Meeting Next Month

A highpoint of the American Mosquito Control Association's 1959 annual meeting will be a half-day discussion by a panel of experts and the audience on current operational problems in mosquito control.

According to meeting chairman, A. D. Hess, of the U. S. Public Health Service, Greeley, Colo., questionnaires have gone out to all mosquito abatement agencies in the U. S. to obtain discussion ideas for this "Operations Clinic."

Scheduled for April 12-15 in the Hotel Utah, Salt Lake City, the annual meeting will include several other innovations of interest to operations groups, as well as to personnel from academic or research institutions.

AMCA members and other persons interested in mosquito control may attend. To obtain further details on the program, registration, and accommodations, write A. D. Hess, U. S. Public Health Service, P. O. Box 625, Greeley, Colo.

W. Pa. PCA Elects Neighly

Francis M. Neighly, Sr., Westmoreland Extermital Termite Service, Latrobe, Pa., was elected governor of the Western Division, Pennsylvania Pest Control Association, at the division's January 8 meeting in Pittsburgh.

Serving with Neighly this year are Milton Zlotnick, Pittsburgh Pest Control Co., Homestead, vice governor; Harry Katz, Elco Manufacturing Co., Pittsburgh, recorder; and Nathan Page, Germ-o Sanitary Co., Pittsburgh, comptroller. New executive committeemen are John J. Ebner, National Pest Control Co., Pittsburgh; and Martin Hersh, Hersh Exterminating Service, Sharon.

Ill. PCA Holds 1-Day Clinic

A special one-day pest control clinic, sponsored by the Illinois Pest Control Association, drew about 75 Chicago PCOs to Oak Park, Ill.'s Oak Park Arms January 14 for seminars on insurance and the biology and chemical control of the resistant German cockroach.

Speakers included Jerry Goodman, B. & D. A. Weisburger, New York, N.Y.; Howard Rosenbaum, Mercury Chemical Co., Chicago; William Eichler, head of Prentiss Drug & Chemical Co.'s Chicago office; and PCO Robert Berns, Aerosol Engineers, Chicago.

Speakers and special guests on hand at the Annual Cal-Poly Conference hosted by California State Polytechnic College, Pomona, Calif., included, left to right, standing: Dr. Leland Brown, University of California, Los Angeles; Dr. Barry Tarshis, UCLA; Dr. Jerome E. Dimitman, Cal-Poly; Roy Pence, UCLA; Dr. John F. Lamiman, Cal-Poly; and Doane Stewart, Dow Chemical Co., Seal Beach, Calif. Sitting, left to right: Wayne K. Davis, Ailing House Termite Inspection Bureau, Oakland, Calif., NPCA president; Dr. Kenneth R. Hobbs, Cal-Poly; John P. Riebel, Cal-Poly; and Arnold Mallis, Gulf Research and Development Co., Pittsburgh, Pa. The meeting featured talks on business; fumigation; control of various structural, ornamental, and fabric-infesting organisms; plus lab sessions on domestic rodent and ectoparasite identification. The conference was sponsored jointly by Cal-Poly and Pest Control Operators of California, Inc.

North Carolina Pest Control Assn. officers for 1959-60, elected at the North Carolina State College PCO Short Course January 6-8, include, first row, left to right: president, David Dodd, Jr., Carolina Chemical and Pest Control, Monroe; vice president, Marvin Scull, Allied Exterminators, Inc., Durham; secretary-treasurer, H. E. Frye, Frye Exterminating Co., Raleigh; and board member, Ivey Coward, Ivey Coward Co., Inc., Greenville. In the second row are, l-r, board members, J. E. Hutto, Orkin Exterminating Co., Rocky Mount, and J. F. Goforth, Arrow Exterminators, Inc., High Point. Board member, Reeves Gressett, Jr., Pied Piper Exterminating Co., Inc., Gastonia, was not present when foto was taken.

Canadian Conference Mar. 23-24

The 17th Annual Canadian PCO Conference March 23-24, in Toronto's Prince George Hotel, will be slanted toward the problems of the small operator. Program topics cover business, serviceman training, difficult pest problems, PCO legislation, new markets, equipment, chemicals, and sanitation.

Registration fee is $14.50 for PCOs or a company representative, $6 for each additional employee, and $3 for wives of those registered.

For more details write V. F. Prentice, Bikoe Manufacturing Co., Ltd., 259 Parliament St., Toronto 2, Ontario. He is conference committee chairman.

Ala. License Test March 17

Alabama license examinations for general pest control and related services will be given March 17 at 8:30 a.m. in five Alabama cities.

The permit fee of $10 is to be paid at the time the examination is taken. For more details, write B. P. Livingston, Chief, Division of Plant Industry, Alabama Department of Agriculture and Industries, State Office Building, Montgomery 1, Ala.

Wanted: Managers For Branch Offices

Rapidly expanding pest control firm requires high-type men to manage offices. Must have initiative, sales ability and forcefulness. Prefer graduate entomologists with practical experience. Will also consider applications from men now in the pest control field, who possess good education, sound technical and business background. Excellent opportunity to become associated with progressive organization enjoying solid financial position. Salary and percentage. Submit complete data: age, education, experience and other pertinent details, together with photo. All replies strictly confidential.

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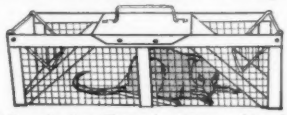
Open at both ends. Animal walks in unsuspectingly



Both ends shut. The animal is caught unhurt

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RATS, SQUIRRELS, MICE, SKUNKS, RABBITS, COONS, WOODCHUCKS, ETC.

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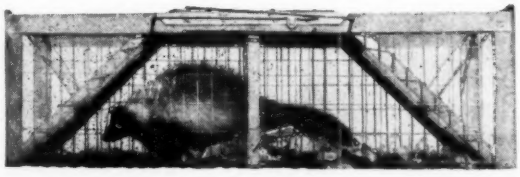
An Amazing Trap



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No. 1	**5x5x18" Rats**	**$ 4.80**
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4 powerful weapons for better PEST CONTROL

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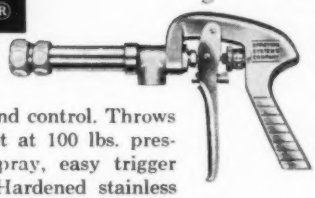
SPRAY GUNS



For fast coverage and control. Throws spray up to 49 feet at 100 lbs. pressure. Adjustable spray, easy trigger control and lock. Hardened stainless steel tips. Choice of capacities. Write for Bulletin 80.

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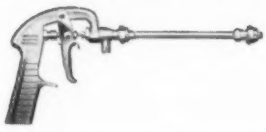
Series No. 22
SPRAY GUNS

Inlet body, cap and orifice tips supplied in choice of brass or stainless steel For use with wide range of interchangeable orifice tips. Extensions available in 8", 18", 24" and 48" lengths.



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Far reaching spray with air pressure. Quickly covers large area and hard-to-get-at places. Nozzle parts made of stainless steel. Write for Bulletin 76.

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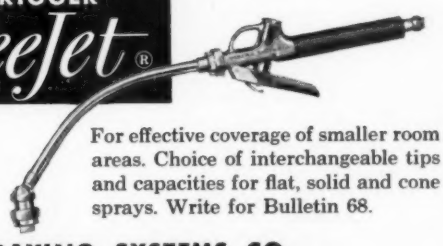

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Notebook

TIPS AND IDEAS FROM THE FIELD

Elm Leaf Beetles: Suit Control To A Tree

by Dr. Ellsworth H. Wheeler
Extension Entomologist
University of Massachusetts
Amherst, Massachusetts

One of the most difficult nuisance insects a PCO may be up against in and around the home during fall, winter and early spring is the elm leaf beetle, which enters the home for hibernation. Although a nuisance, these beetles cause no damage in the house except occasionally staining curtains, wallpaper, and painted surfaces.

They are about ¼-inch long. Younger beetles are dull yellow and have dark stripes along the edge of each wing cover. As they grow older, they turn a uniform dull, olive green. In May and June, the beetles that survive the winter feed and lay eggs on elm leaves. Feeding by grubs or larvae continues into July, causes leaves to curl and turn brown.

Elm leaf beetle, left to right: adult, larva, pupa. In the fall, the beetles may enter a home by crawling down chimneys, or through openings under eaves, around windows, doors, or ventilators. Eggs of elm leaf beetles are small, yellow, and spindle-shaped. The larvae hatch in about a week

Although large numbers of these insects can be killed in the home with almost any of the common household insecticides, dozens or even hundreds of the beetles may remain tucked away undetected in wall spaces, attics, window casings, and under shingles or siding. These will try to get out as they are warmed-up by the sun or furnace. The PCO's job is further complicated by the annual renewal of populations from elm trees near the infested home.

Best control is obtained by preventive treatment. Spray elms in early June and again in mid-August with DDT or some other recommended chemical. This protects the foliage from elm leaf beetle attack, and thus cuts down on the number of beetles that will seek hibernation spots in nearby homes during the next fall. Once in the house, these beetles may remain until well into the spring.

If, in your control operations for elm leaf beetles, you employ hydraulic sprayers, use 2 pounds of a 50% DDT wettable powder or 1 quart of a 25% DDT emulsifiable concentrate per 100 gallons of water. Spray trees uniformly until insecticide begins to drip.

To make 100 gallons of spray for application with a mist blower, add 24 gallons of a 25% DDT emulsifiable concentrate to 76 gallons of water. This makes a 6% emulsion that is ready to spray. Apply it lightly but completely to foliage. Only about 1 pint to 2 quarts of 6% DDT spray is needed to cover small to large elms. Lower concentrations may be used in proportionately larger amounts. Consult your mist blower manufacturer for exact details.

For small trees which can be reached by hand equipment, use 10 tablespoonfuls of lead arsenate or 2 tablespoonfuls of 50% DDT powder to each gallon of water.

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METHYL BROMIDE

Great Lakes Chemical offers fumigators a unique combination of *personal service plus* the assurance of *dependable supply* that only an integrated prime producer can give!

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This amazing FUMO - KILL insecticide is by all qualifications a leader in its field.

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EASY TO USE: Requires no Special Equipment.

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FUMO-KILL is truly the modern method of insect extermination. Light match to contents of can, will produce fumes—NO FLAME. Non-hazardous. This amazing FUMO-KILL insecticide has been tested, and found effective against most types of household pests.

FUMO-KILL can be obtained in 2 oz. (enough for up to 6,000 cubic feet)—4 oz. and 1-lb. cans.

Cost of 12—2-oz. Cans ..... $ 7.50 per doz.
Cost of 12—4-oz. Cans ..... 13.50 per doz.
Bulk ..... 4.50 per lb.

Delivery Charges Prepaid

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The New Effective Fumigant That Will Kill

Mosquitoes, Flying Moths, Spiders, Silverfish, Flies, Wasps, and Exposed Waterbugs, Roaches, Bedbugs, and Ants

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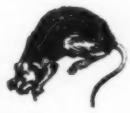

Cereal baits, pellets, or liquid bait with freeze resistant and evaporating retardant chemicals. Available with Warfarin or P.M.P. anticoagulants. Also with Thallium Sulphate, a fast killing, economical lethal poison.

	Distributor's Cost
Thallium Sulphate concentrate	**$7.50 per lb.**
Round Metal Rodent Bait Stations	**1.25 each**
Rat Jiggers, can't tip	**5.62 M**
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Infestation Report

Contains pertinent portions of the Department of Agriculture's **Cooperative Economic Insect Report**, material from university entomology departments and reports from readers. PCOs noticing infestations in their own areas are urged to communicate with **Pest Control** so their information may be added to this infestation report.

DERMESTID BEETLES

Virginia: Larvae present in two packages of cayenne pepper when opened, Blacksburg, Montgomery County.

EARWIGS

Louisiana: Heavy in slab homes, New Orleans area.

ELM LEAF BEETLE
(Galerucella xanthomelaena)

Kansas: Reported from Dodge City, first record for state.

GIANT HORNET
(Vespa crabro germana)

Georgia: Collected at Carnesville, Franklin County—first record of this species for state.

TERMITES

California: Unusually heavy swarms of Reticulitermes hesperus in Los Angeles County. Recent rains following long, dry period apparently brought out sexual forms. **Wisconsin:** A University of Wisconsin entomologist is to begin study of termites which infest Sheboygan residences during the winter.

TROPICAL RAT MITE
(Ornithonyssus bacoti)

Texas: Annoying residents in Vernon, Wilbarger County.

A ZORAPTERON
(Zorotypus hubbardi)

Oklahoma: Specimen found in decaying sawdust near Harris, McCurtain County—first record for state.

1959 Southern Conference

(from page 55)

December, January, and February — the three considered by most others to be the slowest for sales.

"That's why they are such good months," Dr. Truman feels. "The customer you're calling on hasn't seen a salesman for weeks. Yet if you wait until warmer weather to make all the big calls, the customer may be off fishing or vacationing."

Wesley F. Brandenburg, Kemper Insurance Co., Dallas, closed the business program with a review of all major lines of insurance coverage available to PCOs and tips on how to stay well protected.

General chairman for the 1959 Southern Conference was Clayton Wright, C. Wright Associates, Dallas. Noad Corley, Corley Pest Control, was local conference chairman. Site for the 1960 conference will be selected on the basis of a poll to be made among industry members who have attended the last three Southern Conferences.

1959 Eastern Conference

(from page 46)

three to five days prior to application so rats will be sufficiently hungry but will not have migrated to a new food supply. The dump should not be burned until at least two days following the application. About 300 pounds of prepared bait is required for a large dump; never less than 50 pounds for any dump. Approximately ½ ounce of bait should kill a 17 ounce rat.

For the control of mice, Faulkner recommended strychnine on crushed oats. The oats should be crushed so the poison can act on the groat. Other possibilities: 50% DDT dust or zinc phosphide with crimped oats. Crimped oats may be obtained through any Farmers Co-op, Faulkner remarked.

The point was brought up from the floor that quick kill creates a carcass nuisance requiring extra labor time. Faulkner disagreed, pointing out that quick kill is what the customer wants. After the kill, then use anticoagulants to clean up, he said.

Joseph Harris pointed out that in states where it is unlawful to kill squirrels, naphthalene flakes impregnated with formaldehyde can be used to drive squirrels out; then necessary precautions can be taken to prevent their re-entry. Where squirrels can be poisoned, thallium sulphate-impregnated peanuts should give adequate control, it was stated.

Other program participants included: the University of Massachusetts' Dr. Charles P. Alexander, head of the Department of Entomology and Plant Pathology, and Professor J. B. Ludtke; Professor Samuel Atkinson, Boston University; Arnold Mallis, Gulf Research and Development Co., Pittsburgh, Pa.; Robert Hodgson, New England Telephone Co.; and PCOs J. Arthur Jones, South Jersey Exterminating Co., Camden, N.J., and Robert Troup, Harder Extermination Service, Inc., Hempstead, N.Y.

At the annual conference banquet, Dr. Ralph E. Heal, NPCA executive secretary, presented a dissecting microscope to Dr. Alexander, who is soon to retire as entomology section head at the University of Massachusetts. The presentation was on behalf of the members of the Eastern Conference.

According to Dr. Frank Shaw of the university's Department of Entomology and Plant Pathology, and Conrad Bohman, Bohman Brothers, Inc., Rochester, N.Y., conference committee chairman, the 20th Eastern PCO Conference is tentatively scheduled for January 27-29, 1960.

Calendar

Central Midwest District Pest Control Meeting, Town House Hotel, Kansas City, Kan., March 9-10.

Pennsylvania Pest Control Assn., Western Div., March Meeting, Webster Hall Hotel, Pittsburgh, March 12, 8 p.m.

(Texas) Professional Pest Control Assn. of Dallas County March Meeting, El Chico Restaurant, Dallas, March 12, 7 p.m.

New Jersey Mosquito Extermination Assn. Annual Meeting, Hotel Haddon Hall, Atlantic City, March 18-20.

Northwest Pest Control Assn. March Meeting, Standard Club, Minneapolis, Minn., March 19, Noon.

Wolverine Pest Control Assn. March Meeting, Biological Station, Gull Lake, Mich., March 19, 6 p.m.

Michigan State University Annual Pest Control Operators' Institute, Kellogg Gull Lake Biological Station, Gull Lake, Mich., March 19-20.

Virginia State Pest Control Assn., Washington, D.C. Pest Control Assn. Annual Joint Meeting, Continental Hotel, Washington, D. C., March 20.

Arkansas Pest Control Assn. March Meeting, Little Rock, March 21, 10 a.m.

Canadian PCOs' 17th Annual Conference, Prince George Hotel, Toronto, Ontario, March 23-24.

Tenth Annual Meeting of the Middle States Public Health Assn., Hotel Savery, Des Moines, Ia., April 1-3.

Western Regional Conference, Institute of Sanitation Management, Statler Hilton Hotel, Los Angeles, Calif., April 2-4.

American Mosquito Control Assn. Annual Meeting, Hotel Utah, Salt Lake City, U., April 12-15.

Chemical Specialties Manufacturers Assn. 45th Mid-Year Meeting, Drake Hotel, Chicago, Ill., May 18-20.

National Assn. of Sanitarians, 23rd Annual Educational Conference, Deauville Hotel, Miami Beach, Fla., June 22-26.

Florida Pest Control Assn. Annual Convention, Clearwater, June 25-27.

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The ORB BOMB contains a high potency non-toxic formula made especially for commercial and industrial use. Only 2 seconds is needed to treat 1,000 cu. ft. of space for flies. Controlled spray rate prevents waste. Fine particle size eliminates spotting. For use in control of houseflies and fruit flies. May also be used in controlling resistant roaches in areas where a non-toxic spray must be used. In ¾, 1¼ and 3 lb. sizes.

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All Aerosol Products with Your Private Label at Minimum Printing Charge.

Write Us For Prices And Details

ORB INDUSTRIES Wallingford Rd. Springfield, Pa.

Will Buy Pest Control Businesses

•

We are ready to buy several more pest control companies to add to the Commonwealth group. We prefer to retain existing management and personnel, under lucrative profit-sharing arrangements offering unusual potentialities for greatly enhancing present income. All negotiations completely confidential.

•

Write William L. Yockey, Comptroller
Commonwealth Sanitation Company
3567 Bigelow Boulevard
Pittsburgh 13, Pennsylvania

Primer

Serviceman Training Outline: 3

by Robert E. Berns
Aerosol Exterminators, Chicago, Illinois

You can buy the latest, proven chemicals and equipment for your servicemen, but the expense is a complete waste if your men don't know how to use them properly. Route personnel must receive careful, thoughtful training.

To help you educate new employees for service work, the writer has organized a ten-part series of outlines to guide the preparation and presentation of serviceman training classes. These outlines cover only the pests the PCO will run into on general service contracts, but others can be added by each individual operator as he recognizes the need. The course of training could take from 10 days to three weeks, depending upon how much time is devoted to it.

LESSONS

Jan.: Introduction, Background
Feb.: Serviceman's Function
✓ **Mar.:** What Is An Insect?
Apr.: Insecticides, Rodenticides
May: Rat & Mouse Control
Jun.: Roaches & Their Control
Jul.: Bedbugs & Their Control
Aug.: Silverfish & Their Control
Sept.: Ants & Their Control
Oct.: Don't Be Half Safe!

What Is An Insect?

Scheduled For (Date and Place)

References

Entomology for Introductory Courses, Matheson, Ch. 3 & 4, 1947. Comstock Publishing Associates, 124 Robert Place, Ithaca, N. Y.

An Introduction to the Study of Insects, Borror & DeLong, Ch. 1-4. 1954. Rinehart and Co., 232 Madison Ave., New York 16, N.Y.

What Is An Insect? Chalk Talk Booklet. Lehker. Department of Entomology, Purdue University, Lafayette, Ind.

Materials

1. Paper mache model of roach
2. Blackboard, chalk
3. Drawings
4. Specimen collection of structural insects

Object

To explain basic insect anatomy

Method

Explain and diagram different Arthropoda; show principal parts of insect anatomy

Presentation

1. Insect distinguished by three body segments, six legs, unique exoskeleton, etc. (Blackboard, model)
2. Arachnida, Chilopoda, Diplopoda, Crustacea and their unique body features (Blackboard)
3. Insect mouthparts — chewing, sucking, sponging, siphoning (Drawings)
4. Respiratory system — spiracles, trachae, tracheoles
5. Nervous system— ganglions, ganglia, ventral nerve
6. Circulatory system — blood, diaphragms, dorsal vessel
7. Eye—simple, compound (Diagram)
8. Auditory organs—Chordotonal organs, Johnston's organ

Demonstration

1. Have trainee handle insect specimens and examine anatomical features under hand lens.

Examination

1. Have student draw on board: body segments, antennae, mouthparts, respiratory features, eyes
2. Simple questions on basic anatomy

Plan New Mallis Edition

A revised second edition of Arnold Mallis' "Handbook of Pest Control" will be published by the end of this year, Mallis has advised PC. In this new edition, some control measures will be revised, he said.

YOU NAME IT — MAGNOLIA HAS IT

Now! Control Resistant Roaches with

DAMATAM E 40

40% Roach Concentrate

A combination of Diazinon, Methoxychlor, Thanite and Malathion in an emulsifiable concentrate that gives results!

1 gal. makes 40 gals. of spray
Order 4 gal. case today.
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50% Malathion — Magnolia Pyrethrum

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Phone Fleetwood 74634
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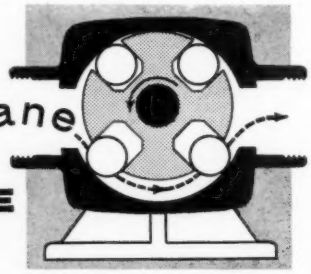
may solve your pump problem



If you are not already using Hypro pumps it will pay you to check on the performance of these compact, low cost, ball bearing, positive displacement, roller pumps.

NO GEARS . . . NO VALVES . . . No metal-to-metal moving parts . . . Hypro pumps avoid many common pump troubles, yet develop pressures up to 150, 250, or 350 PSI (depending on model), even at relatively slow speeds. Outputs range from 5 to more than 60 GPM.

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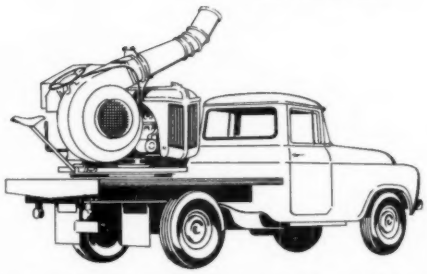
HARDIE AERO-MIST SPRAYER



Hardie Model L-80A mounted on ¾ ton truck allows ample room for full day's supply of chemicals

Now is the time to do something about the insects and pests that will irritate everyone. Control them with the time-tested, full-coverage, high velocity HARDIE AERO MIST SPRAYER. Tested all over America and used by leading commercial insect control companies, the Hardie AeroMist is standard equipment for mosquito control; perfect for treatment of trees infested with bark beetle; (Dutch elm disease); gives matchless performance for control of bark beetles, leaf hoppers, leaf eaters, scale insects, fungus disease, and flies and mosquitoes. Air volume 12,000 to 14,000 c.f.m., and air velocity 130 to 150 m.p.h. Perfect for mounting on the bed of a ¾ ton truck.

Write today for full particulars.

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Div. of Vulcan Iron Works

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Technical Director

We have a very important position for an outstanding man, with entomological and chemical background and a record of successful accomplishment, to head service department of rapidly expanding pest control firm with home offices in Pittsburgh. This is an important position for a man with experience and possessing managerial ability plus. Remuneration to meet full expectations plus opportunity for profit-sharing interest. This is an unusual opportunity for the right man. All replies strictly confidential. Submit account of academic and professional training, past affiliations, earnings, photo and any other pertinent facts to:

L. L. Crosby, President

Commonwealth Sanitation Company

3567 Bigelow Boulevard

Pittsburgh, 13, Pennsylvania

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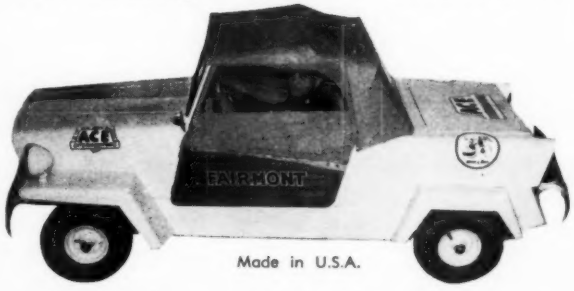

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Termite Inspections—Short Runs & Frequent Stops

This attention-getter is worth a million dollars in advertising alone. Not a toy, but big enough for two people, or for one man on a 3-day Service Route with supplies and equipment. Has everything a big car has except cost, size and expense. One dollar buys a week's worth of transportation. Parking problems disappear and transportation costs go down, down, down.

Only $850.00 f.o.b. factory*

***$25.00 PCO Discount Until May 1, 1959**

Send Today for Free Literature

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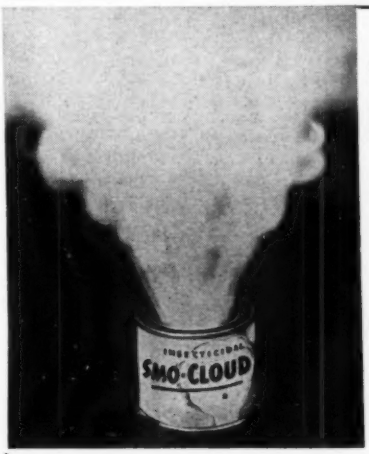

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1 doz. 2 oz. cans
$7.80

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ALSO MOTH-CLOUD and BUG-TAB TABLETS

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Send for **FREE SAMPLES** Today!

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PC

Classifieds

When answering ads where box number only is given, please address as follows: Box number, c/o Pest Control, 1900 Euclid Avenue, Cleveland 15, Ohio.

Rates: "Position Wanted" 5c per word, minimum $2.00. All other classifications, 10c per word, minimum $2.00. All classified ads must be received by Publisher the 10th of the month preceding publication date and be accompanied by cash or money order covering full payment.

POSITION WANTED

TWELVE YEARS EXPERIENCE in management, sales, service in all phases of pest control. Age, late thirties, and excellent health. Willing to relocate for position of responsibility and chance for advancement. Box 494, Pest Control magazine.

MANAGEMENT POSITION wanted. Experienced all phases inside management, route supervision, purchasing, office procedures. Also outside experience doing and supervising termite proofing. Away from industry over one year in intangible sales. Seeking permanent position in pest control or allied industry. College graduate, 31, married. Will relocate. Contact S. A. Forman, 930 Ogden Ave., Bronx 52, N. Y.

HELP WANTED

OPPORTUNITIES UNLIMITED. The world's largest pest control organization (AAA-1 rated) has interesting openings for men with initiative and ambition. We operate in 28 states from coast to coast and there are opportunities open in many phases of our operation . . . servicemen, managers, technical representatives and salesmen. Experience in professions related to pest control helpful, though not necessary. Liberal salary and incentive arrangements provide unparalleled opportunities for men with good judgment and the ability to get along with people. Our firm, over 50 years old, offers employee benefits including paid vacations, sick leave, life insurance, hospitalization and pension plan. All replies confidential. Interviews in Atlanta by invitation at our expense. Write in detail to Orkin Exterminating Co., Inc., 713 W. Peachtree St., Atlanta, Ga. Attention: Personnel Dept.

WANTED: MANAGERS for branch offices. Rapidly expanding pest control firm requires high-type men to manage offices. Must have initiative, sales ability, and forcefulness. Prefer graduate entomologists with practical experience. Will also consider applications from men now in the pest control field, who possess good education, sound technical, and business background. Excellent opportunity to become associated with progressive organization enjoying solid financial position. Salary and percentage. Submit complete data: age, education, experience, and other pertinent details, together with photo. All replies strictly confidential. L. L. Crosby, President, Commonwealth Sanitation Co., 3567 Bigelow Blvd., Pittsburgh 13, Pa.

TECHNICAL DIRECTOR—We have a very important position for an outstanding man, with entomological and chemical background and a record of successful accomplishment, to head service department of rapidly expanding pest control firm with home offices in Pittsburgh. This is an important position for a man with experience and possessing managerial ability plus. Remuneration to meet full expectations plus opportunity for profit-sharing interest. This is an unusual opportunity for the right man. All replies strictly confidential. Submit account of academic and professional training, past affiliations, earnings, photo and any other pertinent facts to: L. L. Crosby, President, Commonwealth Sanitation Co., 3567 Bigelow Blvd., Pittsburgh 13, Pa.

MEN WITH PROVEN RECORDS of expansion in pest control field, to help set up new branches for Midwest pest control company. Successful applicant will be given option to purchase up to 50% ownership of new branch out of earnings. Write giving full details. Central Exterminating Co., Inc., 1647 Superior Ave., Cleveland 14, O.

MANUFACTURER'S REPRESENTA-tives and selling agents wanted by Eastern producer of outstanding anti-coagulant rodenticide, selling PCOs, agricultural formulators, chemical specialty manufacturers, food and grain processors, farm and poultry industry. Protected territories open in East, Middle Atlantic, New England, South East, Mid-South, Southwest, Middlewest, Central, and West Coast. Box 495, Pest Control magazine.

TECHNICAL PERSONNEL wanted by large service-minded company. Duties to assist branch offices in pest and termite control services. Some travel and no sales required. Degree helpful but not essential. Benefits include life insurance, hospitalization, pension, paid vacation, and sick leave. Ample opportunity for advancement. Send resume including salary history. All replies confidential. Interviews in Atlanta by invitation at our expense. Write in detail to Orkin Exterminating Co., Inc., 713 W. Peachtree St., Atlanta, Ga. Attention: Technical Dept.

WANT TO BUY

FORTIFIED RED SQUILL, powder or extract. Advise potency, condition. J. T. Eaton & Co., Inc., 1106 Lakeview Rd., Cleveland, O.

PEST CONTROL BUSINESS or ac-counts New York and/or New Jersey. Lock, stock, and barrel. Cash splash for one to one thousand accounts. Box 496, Pest Control magazine.

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PEST CONTROL BUSINESSES in New York State, New Jersey, Pennsylvania, Massachusetts, and Connecticut. McMahon Brothers, Inc., P.O. Box 34, West View Station, Binghamton, N. Y.

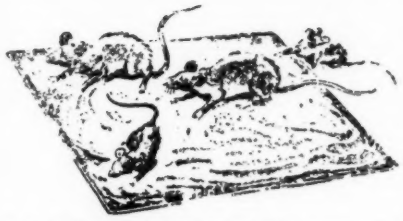
INTERESTED in buying exterminat-ing business in Chicago or Kansas City. Replies confidential. Box 486, Pest Control magazine.

WILL BUY small pest control busi-ness, into established business, or take over management, if desired, on profit sharing basis, in Midwestern states. Box 497, Pest Control magazine.

WILL BUY pest control business in Pennsylvania, Ohio, Kentucky, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, and West Virginia. Write details to R. D. Erdie, 410 Ogden Ave., Fairmont, W. Va.

WILL PAY TOP PRICE for exter-minating business in New York City area. Cash. Replies confidential. Box 439, Pest Control magazine.

WONDER RAT BOARDS



a new type trap to solve difficult rat problems

A felt base with a specially prepared adhesive that is non-drying or hardening. Catches rats like flies on fly paper! Remains active indefinitely. Safe to use. No poisons required. Ideal for use in Food Plants, Warehouses, Etc.

$12.00 a dozen

SPECIAL PRICES TO THE TRADE:

6 dozen (72)	$9.00 per dozen
12 dozen (144)	7.50 per dozen

WONDER RAT GLUE

Sold in bulk so you can make your own rat boards 6" x 6" for mice - 9" x 11" for rats are usual sizes

25 lbs.	$.80 per lb.
50 lbs.	.78 per lb.
100 lbs.	.75 per lb.

ALL PRICES F.O.B. BROOKLYN, N.Y.

Order Today From

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Phone: DEwey 8-4100
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presents
A CORRESPONDENCE COURSE IN

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★ **NEWLY REVISED BY RONALD W. HUNT, B.Sc.**
Commissioner of Examinations and former member of the California Structural Pest Control Board, now Associate Entomologist with the Eleventh U. S. Naval District

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NEW METHODS, MATERIALS AND TRENDS IN THE PEST CONTROL INDUSTRY

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★ **COURSE CONTENT:** arthropods ● insecticides, fungicides, and adjuvants ● fumigation, the common fumigants, soil fumigants ● pest control equipment ● fungi attacking structural timber ● insects other than termites attacking wood and wood products ● a general discussion of termites ● the Western subterranean termite ● the common dry-wood termite ● the damp-wood termites and other species of lesser importance ● structural nomenclature ● the termite inspection ● structural correction ● insects associated with food stuffs ● insects affecting grains, cereal products, fruit and nuts ● insects attacking animal products ● insect pests of fabrics ● arthropods attacking man ● dooryard pests of man ● rats ● laws and regulations covering pest control in California ● the administration of a pest control business ● associations, public relations, salesmanship and advertising in pest control

★ **FEE:** $20; out-of state $25

★ **WRITE:**
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University Extension
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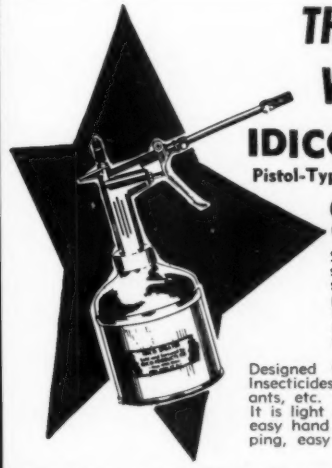
If so, notify our circulation department right away to be certain the magazine reaches you at your new location. The Post Office won't forward your copies. So when you write us, make it at least three weeks in advance of your moving date, and include your old address, as well as the new one. We'll see you don't miss a single issue of PC. Address this old and new address information to:

Circulation Department
PEST CONTROL
1900 Euclid Avenue
Cleveland 15, Ohio

THE FAVORITE WITH PCOs



IDICO STAR
Pistol-Type
SPRAYER

Save money by using a sprayer that delivers small amounts of expensive chemicals direct to infested areas without dripping, flooding or waste.

Designed for Pest Control work: Insecticides, Deodorants; Disinfectants, etc.
It is light . . . compact, has a new easy hand grip control — no dripping, easy to fill.

HAS TWO (2) INTERCHANGEABLE NOZZLES:
1 - Fine Fog Spray
2 - Penetrating Pin Stream (reaches 20 feet)
B1 - One Quart Container (brass bottom) - straight extension - $10.25
. . . on orders of 6 or more units 10% discount . . . all copper container, add $1.00 to price, — Your Best Buy!

IDICO PRODUCTS CO.
1 W. 125th St., New York 27, N. Y.

Please send us _____ units
☐ check enclosed ☐ bill us

NAME _____
ADDRESS _____
CITY & ZONE _____ STATE _____

Pestales

Jamaican run. Nothing wrong with the pest control business in the Midwest—at least around the Columbus, O. area. We hear Joe Mooney and wife (he heads Columbus Pest Control, Inc.) just returned home recently from a vacation in Montego Bay, Jamaica. But the high point of their trip came during a stopover in Havana, Cuba where they arrived in time to witness Batista's flight and the entry of Castro's forces.

* * *

Gives booze the bird. In St. Louis, Mo., city health commissioner, Dr. J. Earl Smith, has a new idea for ridding St. Louis of pigeons — get them tight, then gas them. Dr. Smith plans to put out grain and bread soaked in alcohol or drugs. When the pigeons keel over in a stupor, health crews will scoop 'em up and cart them to the city dog pound gas chamber. *Who knows this'll work, though? It may make pigeons just mad enough, they'll go on the wagon.*

* * *

Philanthropies Dinner for Rosenfeld. Harry Rosenfeld, World Wide Exterminating Co., New York City, was honored at the annual Pest Control dinner of the Federation of Jewish Philanthropies at New York's Gotham Hotel January 15. Joseph Harris of Guarantee Exterminating Co., New York, executive secretary of the N. Y. Pest Control Association, was chairman of the committee in charge of the testimonial dinner.

* * *

Insect instrumentalists. In Indianapolis, Ind., the piano technicians guild's pest control committee is warring on moths that infest piano felt padding and possibly impair the tone of the piano. According to committee chairman Bob Wire, 51% of 1,000 pianos inspected all over the U. S. and Canada recently were found infested. Of those more than 10 years old, 62% were moth-damaged. *So where's Petrillo?*

* * *

No more snatchers! Bernie Scherzinger, Scherzinger Corp., Cincinnati, O., wants what he wants when he wants it, especially when it comes to his copy of PC. Seems his servicemen have been swiping copies as soon as they come in. Bernie'll have no more of that, tho, for now he's having a copy of Pest Control sent to the home of each of his servicemen. Giant Western Exterminating Co., with headquarters in Newark, N. J., advises its 500 servicemen to read each issue of PC. A note in Western's "We-Code" house magazine, for October, advises servicemen to check with their managers to make it available to them. Of course this all sounds like a **wonderful** idea to our circulation dept.

* * *

Space dust. Silica gel, a disiccant or drying agent which may have some use in insect control, is helping roll back space frontiers. According to Davison Chemical Division of W. R. Grace & Co., the chemical has been used to maintain favorable conditions for animals sent into space, and to protect delicate space mechanisms prior to launching. *A ready-made advertising come-on for Davison Chemical — an insecticide "that's out of this world."*

* * *

Gibson: on guard! Arthur W. Gibson of Sentinel Laboratory, Springfield, Ill., has been named an outer guard in the Shrine divan by Springfield's Illustrious Potentate. Gibson has been a member of the Shrine Clown Band since its organization, is a past exalted ruler of the local Elks lodge.

* * *

Mouse injures four. In Foggia, Italy, four persons were injured a few weeks ago when a truck driver saw a mouse scamper across his knee and caused him to lose control of his vehicle. *If Italian trucks are like Italian cars, it's surprising the driver could even see his knee.*

* * *

Midwife to a roach. These Purdue conferences get more educational every year. At the 1959 conference (see pg. 30), William Farris of Anderson Exterminating Co., Chicago, Ill., was on his way out of a class with a box of pinned roach specimens when an egg capsule in the box split open slightly and tiny roach nymphs began to emerge.

One of the group of Jeep mounted Buffalo Turbines used by the South Cook County Illinois Mosquito Abatement District, one of the outstanding control areas in the Nation.

Modern Mosquito Control Includes ALL 3

1. Dusting for Adult Control.
2. Applications of Wetted Granules for Larvae and Pre-hatch control.
3. Liquid Spraying for spot control.

The Buffalo Turbine Sprayer-Duster is the only piece of equipment available today that dispenses dust for adult control and at the same time, dispenses granules for pre-hatch and larvae control — and also sprays liquid for spot control. Applications of treated granules without DDT give results equal to DDT but eliminate build up of resistance. Turbo-Dusting and Turbo-Spraying the Buffalo Turbine way give deep penetration and wide coverage for economical and effective control. Modern Buffalo Turbine Equipment combined with the newest methods provide the most efficient mosquito control at lowest cost.

And ONLY Buffalo Turbine Gives You ALL Three Methods in ONE Sprayer!

Abatement Directors — Mosquito Control Supervisors; Gain all the advantages of these latest control methods with one piece of equipment. Get all the details. Write today!

BUFFALO TURBINE AGRICULTURAL EQUIPMENT CO., Inc.
70 Industrial St.
Gowanda, New York

Perfect Combination

Now, Crag† Fly Repellent With Pyrenone*
For All Dairy and Livestock Applications

It's a perfect combination because Crag Fly Repellent has recently been granted broad approval for use in critical food and dairy areas.

You can even apply Crag Fly Repellent, either alone or in combination with Pyrenone, directly to dairy and beef cattle—on a "no residue" basis. (That's the acid test of *low* toxicity. A test, incidentally, that Pyrenone passed with flying colors some years ago.)

Pyrenone controls fly populations. Crag Fly Repellent repels new invasions. When you combine the two in the same formulation, you get a one-two combination that's hard to beat.

Crag Fly Repellent also extends and improves the effectiveness of residual toxicants. Like always dependable Pyrenone, Crag Fly Repellent is decidedly economical, too.

Today Fairfield Chemicals offers you Pyrenone plus Crag Fly Repellent in oil-base or emulsifiable concentrates. Or if you prefer to make your own combinations, you can also obtain Crag Fly Repellent from our regional offices.

A new Technical Data Sheet entitled "Pyrenone-Repellent Combinations" is immediately available. For your copy, including complete price information, contact your nearest Fairfield representative today. Branches in principal cities. In Canada: Natural Products Corporation, Montreal and Toronto.

Pyrenone
REPELLENTS

†Reg. U. S. Pat. Off., UCC *Reg. U. S. Pat. Off., FMC.

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Fairfield Chemicals
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You can deliver a crushing blow to subterranean termites every time with alkali-stable dieldrin. It's the insecticide proved time and time again in all termite-infested areas.

Alkali-stable dieldrin gives you a deadly barrier. Placed in the soil around the home, it knocks out termites coming and going. You can recommend and use dieldrin with confidence. Even alkaline soil cannot destroy dieldrin's termite-killing effectiveness—especially important in new-home construction where lime, plaster, cement and other materials are present in the soil.

And dieldrin *stays put*. Wherever you apply it, dieldrin remains on the job, killing destructive termites for years.

Protect your guarantee—build sales—build greater customer satisfaction on all of your termite operations, with dieldrin. Complete technical information on dieldrin and its application is available. Write to:

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